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HARVARD UNIVERSITY

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VOLUME XXIX

JAMAICA PLAIN, MASS.
1948

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Arnold Arboretum of Harvard University
KRAUS REPRINT CORPORATION
New York
1968

54687

DEC 12 1968

Smithsonian
Pam
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1948

DATES OF ISSUE

No. 1 (pp. 1–115, 10 pl.) issued January 15, 1948.

No. 2 (pp. 117–215, 12 pl.) issued April 15, 1948.

No. 3 (pp. 217–319, 12 pl.) issued July 15, 1948.

No. 4 (pp. 321–447, 4 pl.) issued October 15, 1948.

Printed in U.S.A.

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JOURNAL
OF THE
ARNOLD ARBORETUM

VOL. XXIX JANUARY 1948 NUMBER 1

HYBRID OAKS OF NORTH AMERICA

ERNEST J. PALMER

THE RECORDED HISTORY of American hybrid oaks begins with the publication (36) of a description of × *Quercus heterophylla* by François André Michaux in 1812. The short Latin description and notes and the excellent colored plate in his Silva give a very good idea of the general characters of the plant. It was believed by Michaux to be a distinct species, but he made the significant statement that it was known only from a single stock on the banks of the Schuylkill River in a field belonging to Mr. Bartram. The plant was later propagated by seeds and cuttings from the original tree and so found its way into a number of botanic and private gardens. There was much debate among early botanists as to whether it was a species or a hybrid, and there has been some difference of opinion as to the identity of the parent species among those who regarded it as a hybrid. All writers seem to have agreed that the willow-oak was one of the parents, but the northern red oak, the black oak, scarlet oak, pin-oak, and Spanish oak (*Quercus falcata*) have all been suggested as the other parent. It is now generally regarded as a cross between the willow-oak (*Quercus Phellos*) and the northern red oak (*Q. borealis*).

Scattered trees discovered in different parts of the country in recent years have been referred to × *Quercus heterophylla* on account of a general resemblance in foliage. There is no reason to doubt that many of these hybrids were identical in parentage with Bartram's oak, but some of them were probably of a different hybrid origin. The controversy over this interesting oak was probably due rather to the conservatism of the early botanists and to their philosophical or theological bias in regard to species than to lack of internal evidence in the material.

Thomas Nuttall described × *Quercus Leana* in 1919 (41), giving a clear description and a good plate as well as a rather full discussion of the tree. He pointed out its similarity to × *Quercus heterophylla* but concluded from a study of material with mature fruit that it was "either a distinct species or another strange hybrid." Mr. Thomas G. Lea, the discoverer of the tree near Cincinnati, Ohio, expressed the opinion in notes quoted by

Nuttall that it was a hybrid, most likely between *Quercus imbricaria* and *Q. velutina* or *Q. coccinea*. Nuttall expressed a doubt, however, as to whether such mixed races occur spontaneously in nature; and so he rather discounted Lea's shrewd and correct surmise as to its origin and relationship and decided to publish it as a species. This hybrid has since turned up at a number of widely scattered stations and it has been brought into cultivation in botanic gardens both in America and in Europe. It seems to be one of the most frequent of natural hybrids, and it may be looked for wherever the shingle-oak and black oak grow in proximity to each other.

In 1863 Dr. Albert K. Kellogg, a keen amateur botanist of California, published a description of × *Quercus Mohreus* (31). This tree was also believed to be a distinct species by the author; but it has since been shown that it is without much doubt a hybrid between *Quercus Kelloggii* and *Q. Wislizeni*.

Dr. George Engelmann was the first American botanist to pay particular attention to spontaneous hybrids among the oaks and to publish notes on them. In a paper presented to the Academy of Science of St. Louis in 1876 (24) he enumerated ten hybrids that he considered well authenticated. Englemann did not propose any strictly new names for the hybrid oaks, but he recognized the hybrid character of × *Quercus heterophylla* and × *Q. Leana*, and he believed *Quercus sinuata* Walter[1] to be a hybrid between the species now known as *Quercus laevis* and *Q. nigra*. He also adopted the name × *Quercus tridentata* for the cross between *Q. imbricaria* and *Q. marilandica*. This was based on *Quercus nigra* (*marilandica*) *tridentata* A. DC. Only the names of the supposed parent species were given in discussing the other six hybrids. Three of the hybrids recognized by Engelmann were between white oak species and seven between black oaks.

Several interesting points were brought out by Engelmann in the general discussion. He mentioned the difficulty of dealing with the question of hybridity in plants when the character of sterility fails, as it was stated, is the case with the oaks where the seeds "come true" and do not revert to the parent forms. White and black oaks, he observed, are too distinct to be crossed; among the white oaks, hybrids appear to be much rarer than among the black oaks — or it may be that they are merely more difficult to recognize; the seeds appear to be as fertile as in true species, but at the same time they do not seem to propagate themselves or to spread in their native woods.

After the publication of Engelmann's paper it began to be recognized among American botanists that natural hybrids do occur between certain species of oaks.

In 1882 Dr. N. L. Britton described × *Quercus Rudkinii* (10) from specimens collected near Keyport, N. J. This was regarded as a hybrid

[1] The name × *Quercus Walteriana* was later proposed by Ashe (5) for this hybrid on the ground that *Q. sinuata* Walt. was, in his opinion, the earliest name for the species described by Small in 1903 as *Quercus austrina*.

between *Quercus marilandica and Q. Phellos.* Other trees supposed to be of the same mixed parentage have since been discovered on Staten Island, N. Y., and at a number of other stations from North Carolina and Florida to Texas. Several other hybrid oaks were discovered during the next quarter of a century and some of them were given binomials by authors who either recognized their hybrid character or regarded them as new species.

Dr. William Trelease entered the field in 1917 with a paper on naming hybrid oaks (64). In the introduction he called attention to the fact that two methods of designating plant hybrids were approved by the Botanical Congresses of Vienna and Brussels — one by giving the names of the parent species separated by the conventional × sign; the other by using a binomial preceded by the same sign. In discussing the desirability of giving binomials to recognized hybrids he suggested that such names rest upon a different basis from those of real species that are distinguished by constant morphological differences; and that since they must be applied to a variable group of plants having a common mixed parentage, they are merely a phase of nomenclature rather than of taxonomy. Some of the difficulties of using the first method were shown and examples were given of the complications that arise when a new name is taken up for one or both of the parent species. A list of the hybrid binomials previously published was given in this paper and 25 new ones were proposed. Type specimens were designated and brief descriptions accompanied by plates were given for two of the newly named hybrids. These were × *Quercus paleolithicola* and × *Q. Schuettei.* For the other hybrids only the supposed parentage was given, except for brief explanatory notes on a few of them.

A second and fuller treatment of the recognized hybrids was incorporated by Trelease in his monographic work, The American oaks, published in 1925. In that work 55 hybrids were named, six of them under new binomials, and another, × *Quercus Byersii*, was credited to Sudworth in lit. Several previously published names were treated as synonyms. Brief descriptions were given of the newly recognized hybrids as well as of some of those named in the earlier publication, and bibliographical references were supplied for all of them.

Although most of Trelease's monograph was devoted to descriptions of the oaks of Mexico, it is a curious and perhaps a significant fact that no hybrids were recognized in that region. Fuller evidence will in all probability show that they are at least as abundant relatively south of the Rio Grande as in the United States, and it is not unlikely that a number of species recently described from Mexico will prove to be of hybrid origin.

In the interval between the appearance of Trelease's two publications Professor C. S. Sargent contributed a paper (53) in which 11 new hybrids were named and described and a variety was proposed for one of those named by Trelease, (× *Quercus subfalcata* var. *microcarpa*). Type specimens and other collections were cited by Sargent for his newly proposed

hybrids. A description was also given of × *Quercus Millechampii* Trelease, and an amplified description of × *Q. dubia* Ashe. The latter was held to be a cross between *Quercus cinerea* and *Q. laurifolia*, and × *Q. atlantica* Ashe and × *Q. sublaurifolia* Trelease were given as synonyms.

Several new hybrids have been named and described since the publication of the papers by Trelease and Sargent, and a number of references to hybrids or supposed hybrids among the oaks have appeared in botanical papers and plant lists without binomials having been proposed for them.

A large amount of material of known or suspected oak hybrids has been brought together in the herbarium of the Arnold Arboretum and many of the hybrids have been grown here both from grafts and from seeds taken from the native trees. This paper is based largely on a study of the herbarium and living material in the Arboretum and on observations and notes made on native trees in many parts of the United States. A few specimens have also been examined in the Gray Herbarium and in the herbarium of the New England Botanical Club. Only a beginning has as yet been made in the study of oak hybrids, and much more field work and experimental work will be necessary before many doubtful questions can be resolved. Some hybrids are so well authenticated by ample material and by the obvious intermediate characters of the plants that there can be little or no reasonable doubt as to their identity. Other identifications must be regarded as merely hypothetical, and in some cases it is very doubtful whether the parentage that has been imputed to them is the correct one or whether they are really hybrids. Some cases of doubtful identity are discussed in this paper after an examination of the material and evidence available, but it is not possible to decide definitely on all of them. But since hybrids are likely to be found in our native woods wherever two or more species of oak of the same section or subgenus grow together, and since they are a source of perplexity to most students, it may serve a useful purpose to bring together a list of those that have been named or that can be recognized with some degree of certainty, and to review briefly the evidence on the subject.

The doubts entertained by the early botanists as to the occurrence of "spontaneous mixed races in nature," as expressed by Nuttall, are understandable when the views generally held at that time as to the origin and nature of species are taken into account. But in view of the accumulating evidence, it is scarcely to be believed that any competent observer would today question the existence of natural plant hybrids or that he could fail to find examples of them in the field, if he keep his eyes open. Hybrids among the oaks are probably much commoner than they were believed to be by most botanists even a few decades ago, and it seems probable that most if not all of the species within the sections of the annual-fruited (*Leucobalani*) and the biennial-fruited (*Erythrobalani*) are inter-fertile under the right conditions. But while this is true, it must not be inferred that individual trees of hybrid origin are relatively abundant in nature. A keen observer with a general knowledge of the native species is likely

to find hybrids by careful searching in any region where compatible species grow in close proximity; but he will probably encounter hundreds of thousands or even millions of trees of the different species for every hybrid. It is more than thirty years since the writer became interested in hybrid oaks, and for many years he has been on the outlook for them while collecting in many parts of the United States. It is perhaps not claiming too much to say that a certain skill and understanding of the problem has been developed. But in all this time and over so wide a territory probably not more than a few hundred trees of unquestionable hybrid origin have been encountered.

The greatest care and caution are necessary in studying hybrid oaks both in the field and in the herbarium. Observations and field notes on the compatible species growing in the vicinity of the supposed hybrid are most important in determining the parentage, and this often limits the possibilities very narrowly. There is no way of determining definitely which parent species was the sire and which the mother tree, although, as will be shown later, it may in some cases be inferred with considerable probability. It is the conventional practice to write the names of the supposed parents of a natural hybrid in alphabetical order, as *Quercus alba* × *bicolor*, and not the reverse.

It must not be assumed that all aberrant forms are to be explained as hybrids. Adventitious shoots, sterile branches and juvenile growth often produce leaves of abnormal types or texture in many of the oaks. Sometimes after a period of drought followed by abundant rain trees will put out new growth with leaves very different from the normal ones of the species. The same thing may happen if the tree is defoliated by insects and a second growth of leaves develops. In some cases these and other monstrous forms of leaves have some resemblance to the leaves of hybrids, and the uncautious or inexperienced student is likely to be deceived by them. Without full material and a careful study of the living plants the identification of spontaneous hybrids can sometimes be only tentative and hypothetical. The fact of hybrid origin and the parentage of the cross must be inferred from certain stigmata and from the intermediate character of the leaves, fruit and other parts of the plant. In a hybrid these marks run through the entire plant and are not confined to certain shoots or branches, as is often the case in abnormal growth resulting from injury or arrested growth, and they differ also in character from monstrous forms, in which the leaves of entire plants sometimes become flabellate, laciniate, crisped or otherwise distorted.

It may be assumed that the ideal hybrid of the first generation would be exactly intermediate in characters between the parent species, but it is quite unlikely that any such perfectly balanced individual could be found in nature. There is wide variability in different parts within every species of oak, as in most other plants, and in a hybrid the different, variable characters of the parents may be combined in various ways or any of them may be predominant or subordinate in different degrees. Latent char-

acters or tendencies in the parent species may also be brought out or may be accentuated. Examples of this may be seen in the extremely large winter-buds of some hybrids, in strange and exaggerated leaf patterns and in an accelerated rate of growth.

The most obvious and easily detected hybrids are those between species in which the leaves are narrow and nearly or quite entire, as in the willow-oak, shingle-oak, laurel-oak or live oak, and species with broad and deeply cut leaves. Hybrids of this character were the first to attract attention, and their parentage can sometimes be determined from the leaves alone or with the aid of field observation. The leaves of such hybrids are generally extremely variable in outline and they are often bilaterally asymmetrical. Some of them may be unlobed, as in the entire-leaved parent species; in others the margins may be irregularly undulate, or there may be one or more rounded or sharp pointed lobes on one side or on both sides of the blade. In rare cases the lobes on vigorous shoots may be prolonged or exaggerated beyond anything found in the parent species. It is as if the growing plant had become bewildered between the two leaf-patterns and the cells did not know which direction to take or how to arrange themselves.

In some hybrids in the white oak section, such as those between the chestnut-oaks and species with deeply cut leaves, symmetry of outline is usually preserved but the lobes are almost always simple and intermediate in length between those of the parents. In many species of *Quercus* the fruit is less variable and is of greater diagnostic value than the leaves. This is equally true in hybrids, and in many cases mature acorns should be seen before definite conclusions are reached as to the parentage. Unfortunately, many hybrid oaks are without fruit, either because they are found as juvenile plants or because of a real tendency to sterility. The latter may be true in some cases, but some hybrid trees produce fruit in great abundance. Hybrids between species in which the acorns differ greatly in size, shape or character of the cup-scales can usually be detected by the intermediate type of fruit; winter-buds and bark may furnish valuable clues, and these are particularly valuable in identifying hybrids between species with similar leaves. In general it may be said that the facility and certainty with which any natural hybrid can be identified is in inverse ratio to the similarity of the parent species.

Among common American oaks there are a number of closely related and similar forms, most of which have been treated as distinct species by some authors and as subspecies, varieties or forms by others. Some examples are *Quercus borealis* and *Q. maxima; Q. Shumardii, Q. texana* and *Q. Schneckii; Q. falcata* and *Q. pagoda; Q. laurifolia* and *Q. obtusa; Q. virginiana, Q. minima* and *Q. geminata; Q. macrocarpa* and *Q. mandanensis; Q. Muhlenbergii* and *Q. prinoides; Q. stellata* and *Q. Margaretta;* and *Q. Durandii, Q. breviloba* and *Q. austrina*. A number of others are found in the western and southwestern states. Whatever status is given to such closely related oaks, it may be assumed that hybrids would be at least as likely to arise among them where the different pairs or groups grow in

proximity as between more distantly related species. But in most cases it would be extremely difficult or impossible to recognize or to identify such hybrids on morphological evidence. It is not unlikely that some of the slightly atypical forms that occasionally turn up to confound students and authorities may have originated from such crosses.

Sargent in his description of × *Quercus Harbisonii* gave the parentage as *Q. stellata* var. *Margaretta* × *virginiana* var. *geminata*, and this according to Trelease is *Q. geminata* × *Margaretta*. But plants that appear to be hybrids between the typical forms of *Quercus stellata* and *Q. virginiana* have been found in several places and an artificial hybrid between the species was produced by Ness. The type specimen of × *Quercus Harbisonii* was labeled *Q. minor* (*stellata*) × *virginiana* by the collector, and I can see no convincing evidence in the specimen that it was not a cross between the typical forms of the two species, nor that it differs in any important character from the other specimens believed to be crosses between the post-oak and the live oak. The supposed parentage of × *Quercus pseudomargaretta* was given by Trelease as *Q. Margaretta* × *stellata*. According to Sargent *Q. Margaretta* is a variety of *Q. stellata;* so in this case we would have, if we follow Sargent, a cross between two varieties of the same species. But even if the two are held to be distinct species, they are so similar in foliage, fruit and other characters and are so closely connected by intermediate forms that recognizing a hybrid between them would seem to require some faith and imagination. A similar situation exists with reference to other hybrids in which one of the supposed parents is of debatable specific or varietal rank. *Quercus Shumardii* var. *Schneckii* was named as one of the parents of × *Quercus Shirlingii* Bush and of × *Q. mutabilis* Palmer & Steyermark, but except on grounds of propinquity, it would have seemed just as probable that the typical form of *Q. Shumardii* was involved. If *Quercus borealis* and *Q. maxima* are regarded as distinct species, it becomes a question which of them was one of the parents in such hybrids as × *Quercus heterophylla*, × *Q. Hawkinsii*, and others. According to Trelease, × *Q. heterophylla* is a cross between *Q. maxima* and *Q. Phellos*. If this is accepted and *Q. borealis* is held to be a distinct species, a cross between it and *Q. Phellos* would be another hybrid and should receive another name. It is not unlikely that both forms of the northern red oak may have hybridized with the willow-oak or with other species at times, but it is scarcely possible that any marked differences between them could be found or recognized in spontaneous plants.

The question of varieties of a named hybrid also arises. Can or should forms or varieties of the hybrid "species" be recognized and named? Sargent, as mentioned above, proposed a variety of × *Quercus subfalcata*, and Baenitz in his description of × *Q. Benderi* subdivided it into the variety *coccinioides*, with a forma *voluto-annulata*, and variety *rubroides*, indicating which parent species the hybrid resembled more closely. Such subdivisions might be multiplied indefinitely, since it must be expected

that hybrids of identical parentage will be widely variable. To attempt to give distinct botanical names to all such forms would, in my opinion, result in complications that would more than offset any advantages. But in the case of plants of particular ornamental or economic value and of distinct appearance, it might be worth while to give them horticultural names.

Only a single tree of × *Quercus heterophylla* and of × *Q. Leana* had been discovered when they were described, and while a number of examples of both of them have since been found, they are both comparatively rare as wild plants. This is true of all hybrids, and it affords some aid in detecting and distinguishing them. But the fact that a form of oak is rare or unique in a locality does not prove it to be a hybrid though it may strongly suggest it; for real species are seldom found so isolated unless the tree is beyond its general range, and in that case it will usually be known to be abundant elsewhere.

Hybrids are most likely to occur in nature along the margins of the range of one of the parent species or where one is locally rare and the other abundant. The reason for this is rather obvious; the chance of the rare plant being pollinated by one of its own kind is small or nonexistent, except in so far as it may be effected by self-pollination. On the other hand, the chance of its pistillate flowers being fertilized by the wind-borne pollen of the dominant species is very great. In the case of a hybrid found under such circumstances it may almost be assumed that the rare species was the mother plant.

It may be stated as a general principle that, other factors being equal, the chance for the production of natural hybrids between compatible species increases in proportion to the numerical inequality of the parent species in the immediate vicinity. Another significant implication of this fact is that in hypothecating the parentage of a hybrid, especially if it is an old tree, it is not absolutely essential that both species be found growing with it, providing they are natives of the region and are known at no great distance. For if one of the parents was a lone individual it may well have disappeared from the locality.

While collecting in southern Illinois in 1919 and 1920 my attention was first called to this principle as applied to hybrid oaks. The willow-oak (*Quercus Phellos*) barely enters the state from the south near the junction of the Ohio and Mississippi Rivers. A few scattered specimens were found in Alexander, Massac, and Pulaski counties in a region where the pin-oak (*Quercus palustris*) is a common and dominant species. In almost every locality where there was a single large willow-oak — and in some where none was seen — obvious hybrids between this species and the pin-oak were found. Some of the hybrid plants were mere sprouts that probably would not long survive, but several had attained considerable size. Similar evidence has been obtained in regard to other hybrids at different localities. Specimens of × *Quercus Leana* are often found along the border of the range of the shingle-oak, and of × *Q. Saulei* where *Q.*

alba is locally dominant and *Q. montana* rare. In the localities where × *Q. bimundorum*, described in this paper, has appeared the white oak is a common tree and the English oak is known in cultivation in the vicinity, or it may rarely be found as an escape. Obviously, natural hybrids may arise where the parent species are more evenly balanced in numbers, but the chances for them are relatively less.

As may be seen by looking over the literature listed in the bibliography at the end of this paper, most of it deals with accounts and descriptions of hybrids found in nature and with discussions of them. Only a small amount of work has been undertaken so far for the purpose of testing supposed hybrids by growing seedlings on a large scale under experimental conditions, and still less has been done in the controlled production of oak hybrids by cross-pollination.

MacDougall (34) mentioned the generally unreliable and hypothetical character of the evidence as to supposed hybrids in nature and he thought that they should be regarded merely as suggestions to be tested by cultural and experimental methods. He suggested three possible lines of attack on the problem of the hybrid; (1) by synthetizing it from its supposed parents; (2) by making an anatomical examination of the hybrid and the supposed parents; (3) by growing the plants to see whether there will be a separation of the ancestral characters in succeeding generations and a reversion of some plants to the parent species. At the same time he pointed out some of the difficulties and uncertainties as to the results that attend such experiments. Cross-pollination in nature may have taken place under an exceptionally favorable combination of circumstances that can scarcely be reproduced artificially. One or both parent species as ordinarily recognized may in reality have consisted of two or more elementary species which might give quite diverse results in breeding. The characters of the hybrid offspring might be quite different if the roles of the parent species, as to which was the sire and which the mother plant were reversed, as was indicated by experiments with *Oenothera*. After growing a number of seedlings from acorns collected from native trees of × *Quercus heterophylla* and × *Q. Rudkini*, he concluded that the former was without doubt a hybrid between the willow-oak and the northern red oak, but that the evidence was inconclusive as to the hybrid character of × *Q. Rudkini*.

Allard (3) gave an account of seedlings grown from several individuals of × *Quercus Saulei* found in the vicinity of Washington, D. C. About 40 seedlings were grown by him, some of which had attained a height of 15 feet in ten years. The leaves showed considerable variation in outline, with a dominance of *Q. montana* characters in the comparatively shallow, more numerous and uniform lobes and in the presence of more or less whitish pubescence beneath. However, a few individual leaves showed the *Q. alba* influence in the larger, irregular lobes. Different individuals also showed variation in autumn coloring, a number of them assuming the typical red-brown color of the *Q. montana* parent, and others the coppery red of *Q. alba*, while one individual with an obviously *Q. alba* type of

leaves became brilliantly deep-red. In some of the plants the leaves showed a tendency to cling to the branches until late in the season, as in *Q. alba*, while in others they resembled the *Q. montana* parent in being early deciduous. In Allard's paper several other hybrid oaks or supposed hybrids were reported as growing in the vicinity of Washington, and the leaves, fruit, and winter-buds of some of them were figured. One of the most interesting of these was the cross between *Quercus palustris* and *Q. Phellos*, of which two trees were said to be growing in a planting of willow-oaks on Pershing Drive, just east of Glebe Road. The experiments and publications of Gale, MacDougall, and others on hybrid oaks were mentioned, the need for further study and experimental work was suggested.

In 1909 Professor Helge Ness began experiments in the cross-pollination of oaks at the Texas Agricultural Experiment Station, College Station, Texas, and obtained some significant results. The most striking of these was a cross between the overcup oak (*Quercus lyrata*), used as the sire, and the live oak (*Q. virginiana*), as the mother plant. This hybrid has also been found growing spontaneously in several places, and was named × *Quercus Comptonae* by Sargent.

Ness published a brief account of this hybrid in 1918 (39), and a second paper with a fuller account of work on hybrid oaks appeared in 1937 (40). At the time of the first report four of the hybrid trees planted on the College campus had produced acorns although there had been no male flowers, and the pollen for the fertilization of the female flowers must have come from other trees, probably post-oak (*Quercus stellata*) growing in the vicinity. The hybrids were symmetrical trees of rapid growth and with attractive foliage, intermediate in character between the parent species but with the overcup predominant.

In the second paper it was reported that seven trees of the original cross-pollination had grown to full fruiting size and all of them had within the preceding two years produced a profusion of both male and female flowers, and while six of them had matured crops of acorns, the seventh had remained sterile. The leaves of the second generation plants grown from these acorns showed wide variability ranging from forms quite intermediate between those of the overcup oak and live oak to others that could scarcely be distinguished from one or other of the parents. Mention was also made of plantings of live oaks on the college grounds where the trees began to bear female flowers about five years after they were set out but no male flowers until several years later. Yet the young trees so placed that they could scarcely receive pollen from any of their own species bore crops of acorns. Several hundred seedlings were grown from these, and the leaves ranged in character between those of the post-oak and live oak, with forms that resembled neither. Ness also produced hybrids through artificial pollination between *Quercus stellata* and *Q. virginiana*, and between the latter and *Q. bicolor*, and he mentioned a tree in the same planting that had been grown from seed of a white oak growing beside a post-oak, and that was an evident hybrid of the two species.

S. H. Yarnell (72), and W. S. Flory, Jr. and F. R. Brison (25) have more recently published papers on the Ness hybrids and have added valuable additional information about them. A brief paper by Ernest J. Schreiner and John W. Duffield (56) mentions an artificial cross having been made between the white oak (*Quercus alba*) and the English oak (*Q. robur*). Spontaneous hybrids between these species have also been found and are described later in this paper as × *Quercus bimundorum*.

While attempts have been made over a number of years to bring as many as possible of the hybrid oaks into cultivation at the Arnold Arboretum, no experimental work has so far been carried on in growing seedlings in quantity under test conditions for scientific study. In some cases a number of seedlings were grown from seeds taken from spontaneous hybrids or from other cultivated trees, but usually only a few specimen plants were selected from them. Other hybrids were propagated by grafts or by transplanting rooted plants. The conclusions that can be drawn from the collection are, therefore, limited but not without interest.

Records show the following hybrids to be in cultivation at the Arboretum or to have been grown here at some time in the past. Several of those on the list did not live long enough to produce fruit or to be of much value for study and, unfortunately, the records of some of the introductions have been lost and other plants have been destroyed or injured by fires or other causes. Those of which specimens were still growing in the collection in 1946 are marked with an asterisk (*); those grown from seed are indicated by S, grafts by G, and where received as rooted plants by P. In a few cases there is no record.

×Quercus Bebbiana* S, G, P.
" Bushii
" Comptonae* S.
" Deami* S, P
" exacta* S, G, P.
" Fernowi S.
" filialis* S.
" garlandensis S, G
" Hastingsii G.
" Hawkinsi* S.
" heterophylla*, G. P.
" Hillii*, S, G
" humidicola S, G.
" Jackiana* S, G.
" Leana* S, G.
" ludoviciana
var. microphylla P.

×Quercus macnabiana S.
" mutabilis S.
" mutabilis S.
" Rehderi* S, P.
" Robbinsii G.
" Rudkini* S.
" runcinata* S, G.
" Sargentii* S, G.
" Saulei* S, G, P.
" Schockiana G.
" stelloides S, G.
" vaga
" Walteriana S.
" bicolor×montana(?) S, G.
" aliena var. acutissima
×alba* (?) P.

Most plants that have been grown at the Arboretum from seeds of the original hybrids found in nature and a few second generation plants from cultivated trees have reproduced the characters of the hybrid parent more or less closely, and in some cases with remarkable fidelity. There seem to be a few exceptions to this, and it is a question whether other aberrant forms or reversions may not have been discarded in selecting plants for the collection. Only in a few cases were enough seedlings kept to afford a basis for comparison.

× *Quercus Comptonae* was grown from seeds sent by Miss Compton from Natchez, Miss. in 1932, and nine plants were set out, of which four or five were living recently. They made slow growth and none of them attained much size, so only the leaves could be studied. These all showed unmistakably the intermediate character of the hybrid with considerable diversity in each individual and slight average variation in width and lobing on the different plants. It is interesting to find that this hybrid offspring of two southern species is hardy in the Arboretum, as the live oak has never survived the New England winters, although the overcup oak has been successfully grown.

× *Quercus Leana* has been grown from seeds from several sources, and the seedlings kept are all examples of this hybrid though with some variations in foliage and fruit. Five plants of one lot from seed collected in southern Illinois were set out, and two of them have produced fruit. The leaves of the different individuals differ considerably in average size and outline. Most of them show some undulation or traces of irregularity or lobing on some of the leaves. But in two of the plants nearly all of the blades are entire and resemble some broad-leaved forms of the shingle-oak. On the other extreme is one tree in which the leaves are nearly all irregularly lobed or undulate. The acorns are intermediate in character between those of the parent species.

Six plants of a culture of × *Quercus Rudkini*, from seeds of a tree found near Fulton, Arkansas, were set out and the leaves were studied before some of them were damaged or destroyed by fire. In all but one of the plants the leaves are mostly narrowly lanceolate and entire, somewhat resembling those of the willow-oak, though somewhat larger and broader than is usual in that species. But they are thicker in texture, strongly veined and pubescent when young on the under side and are sessile or nearly so and often rounded or slightly subcordate at base, all characters indicating the influence of the black jack oak (*Quercus marilandica*). One tree of the lot had much broader, more irregular and mostly lobed leaves. A tree of × *Quercus runcinata* grown from seed of a tree found in southern Illinois in 1919, has made a remarkably rapid growth and in 1945 it was about forty feet in height with a trunk diameter of about fourteen inches. The leaves are broader and more uniform in shape than those of the parent tree and there is some resemblance to a narrow-leaved form of *Quercus borealis*. But some leaves show a tendency toward eccentric lobing and they are covered with a coat of easily-detached pubescence on the under side while young. The acorns, of which there was a large crop in 1945, are somewhat similar in size and shape to those of *Q. borealis*, but with loose scales on the cups suggestive of the *Q. imbricaria* parent. The two large trees of × *Quercus Sargentii*, from seed of the hybrid tree first recognized in cultivation, both show unmistakably the characters of *Q. montana* and *Q. robur*, although differing noticeably from each other in foliage and fruit. Of three lots of × *Quercus Deamii* from seeds of the original tree none resemble the parent

very closely and in the leaves of two of them there is a strong suggestion of *Quercus bicolor*. None has yet produced fruit.

It has been stated that most or all of the species within the two main sections of white oaks and black oaks are interfertile and that in some cases at least they produce viable fruit in abundance. There is also evidence that some of them reproduce themselves with little change, retaining characters intermediate between the parent species. Since several species are often found growing together in the deciduous forests throughout North America, it may be asked, as Englemann asked, why are hybrids not more common and why do they not tend to spread in their native woods and to become dominant in some areas?

Perhaps there are physiological reasons that tend to reduce the fertility of some oak hybrids, but evidence is lacking on this. And without resorting to such an explanation, probably a sufficient answer can be found in the keen competition for survival and reproduction among plants in nature. In a well occupied forest there is little chance for expansion, and reproduction is held to a minimum except where the pressure is relieved by some extraordinary chance or vicissitude, such as an artificial clearing or thinning or a similar result brought about by such natural causes as fire, hurricane, climatic extremes, or disease among some of the competing species. A large oak tree living for perhaps a century or more may produce literally millions of acorns. But in spite of this almost incredible fecundity, very few of them will ordinarily find a chance to germinate and of the seedlings that do spring up perhaps only one or at best only a very small number is likely to survive and to replace the parent as a fully grown tree. Even under the most favorable conditions for hybridization the chance of the fortunate survivor having sprung from an acorn produced by cross-pollination would seem to be extremely small.

In a hybrid found in nature there is of course no way of determining whether it is a cross of the first or of a later generation. But the probability seems to be very great that it is the first. For if the chance for the development and survival of the original hybrid are so small, the odds against its perpetuation in a second generation are infinitely greater. It has been suggested that certain supposed hybrids found in nature represent crosses between more than two species, or in other words, that the bispecific cross has been recrossed with a third species. The isolated hybrid produced by the fertilization of a rare or single mother plant by another and locally common species would in all probability be pollinated by the dominant species. And so in the improbable case of succeeding generations there would be an increasing tendency to revert to the characters of the male parent. It may be possible that under a combination of particularly favorable circumstances a hybrid might be pollinated by a third species and a compound hybrid result. But the chances for it occurring in nature seem so remote as to be almost negligible. It seems probable, therefore, that the great majority of natural hybrids are first-generation crosses between two species.

Several instances of experiments and results in the artificial production of oak hybrids have been referred to above. But comparatively little has so far been done in this field, although it would seem to be a most promising one both from the standpoint of its practical value and its scientific interest.

In several cases the specific names used for one or both of the parent species in the original publication of hybrid binomials have been changed to conform to more recent usage or interpretation. Among examples are *Quercus nigra* L., long used for the black jack oak but now held to apply properly to the water-oak of the southern states, *Quercus falcata* Michx., which has again been taken up for the southern red oak instead of the doubtful *Quercus rubra* L., *Quercus Primus* L., now used for the basket-oak of the southern coastal plain instead of for the rock-chestnut-oak, which is now called *Quercus montana* Willd., and a number of others. The names originally used are generally shown in parentheses or are explained in the descriptions. Differences of opinion as to the proper use of certain names and in regard to the status of some named species, varieties, and forms still exist among botanical authors. The names currently accepted as valid in the herbarium of the Arnold Arboretum are used in this paper.

The figures in parentheses refer to the numbers of papers listed in the bibliography. Specimens cited that were examined only in the Gray Herbarium are designated by (G); all others are in the herbarium of the Arnold Arboretum.

× **Quercus anceps** hybr. nov. (*Q. falcata* × *imbricaria*).

Arbor foliis obovatis vel oblongo-ellipticis undulatis vel inaequaliter lobatis 9–16 cm. longis 4–10 cm. latis apice acutis mucronatis basi cuneatis vel anguste rotundatis, maturis supra glabris infra fulvo-tomentosis. Fructus ignotus.

The trees from which the type of this hybrid came were found along the margin of upland woods near Rosiclair, Illinois, with both of the supposed parent species growing near by. Other biennially-fruited oaks in the vicinity were *Quercus borealis* var. *maxima*, *Q. marilandica*, and *Q. velutina*. Unfortunately, there were no acorns either on this tree or on another of apparently similar parentage found near Shawneetown, Ill. But the shape, texture and color of the leaves and other characters furnish convincing evidence of the parentage. The narrowly obovate or oblong-elliptic leaves are remarkably variable and many of them are asymmetric in outline. The range of the shingle-oak and of the southern red oak overlap in only a few localities, and the latter was near its northern limit in the locality where the hybrid was found.

ILLINOIS: Rosiclair, Hardin Co., *E. J. Palmer 15455*, June 10. *17031* (TYPE), Oct. 10, 1919; Shawneetown, Gallatin Co., *E. J. Palmer 15560*, June 19, 1919.

× **Quercus Andrewsii** Sargent (*Q. macrocarpa* × *undulata*), Bot. Gaz. 65: 455. 1918. — Trelease, Mem. Nat. Acad. Sci. 30: 13. 1924.

This was described from a specimen taken from a group of large shrubs spreading by underground stems, found in Dewey County, western Oklahoma. Both of the supposed parents were growing near by. The

leaves are intermediate in size and shape between those of the parent species, the pubescence on the under surface being very much like that of *Quercus macrocarpa*. The single acorn on the type specimen is about 2.5 cm. long including the rounded or slightly turbinate cup which covers nearly half of the nut; cup scales pale pubescent, corky thickened toward base, the tips on upper rows prolonged and forming a short, sparse fringe along the rim.

OKLAHOMA: Seibring, *D. M. Andrews 69* (TYPE), Aug. 17, 1915.

Although known from only a single collection, there can be little doubt as to the hybrid origin and parentage of this plant.

× **Quercus Asheana** Little (*Q. incana* × *laevis*), Jour. Washington Acad. Sci. 33: 8. 1943.

× *Quercus Ashei* Trelease (*nomen nudum*), Proc. Amer. Phil. Soc. 56: 48. 1917; Mem. Nat. Acad. Sci. 20: 13. 1924. Not *Q. Ashei* Sterrett, Jour. Elisha Mitchell Sci. Soc. 37: 178. 1922.

Quercus cinerea × *Catesbaei* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 88. 1894. — Small, Bull. Torrey Bot. Club 22: 76, pl. 234–235. 1895.

Quercus brevifolia × *Catesbaei* Sudworth, U. S. Dept. Agric., Div. Forestry, Bull. 14: 170. 1897.

Although no description of this hybrid was given by Trelease, the name and the reference to Ashe's report clearly indicate the source. Two forms were described by Ashe: (1) having the bark and general appearance of *Q. cinerea* (*incana*) but with twigs, buds and fruit somewhat resembling the other parent, and (2) with the general appearance of *Q. Catesbaei* (*laevis*), but with acorns generally like those of *Q. incana*. It was stated that ten or twelve of the first form were seen and several of the latter, but no definite locality was mentioned. The following specimens of this hybrid have been seen:

GEORGIA: Traders Hill, *J. K. Small*, June 12–15, 1895; St. Marys, *J. K. Small*, June 13, 1895; Folkstone, *T. G. Harbison 50*, May 15, 1918, *106*, Nov. 26, 1919. FLORIDA: Ella, Lake Co., *Geo. V. Nash 1577*, Aug. 1894; Umatilla, Lake Co., *Geo. V. Nash 1586*, Aug., 1894; Zellwood, Orange Co., *C. H. Baker 491-a-b-c-d-e*, April 16, 1918; Orlando, Orange Co., *T. G. Harbison 23*, Dec. 5, 1917, *E. J. Palmer 38433*, April 2, 1931; Jacksonville, *T. G. Harbison 1, 6*, Nov. 9, *29*, April 23, 1917; Gainesville, *T. G. Harbison 54*, Nov. 11, 1917, *70*, July 25, 1918; Sebring, *T. G. Harbison 41*, July 29, *63*, July 30, 1918; Haines City, *T. G. Harbison 4*, Aug. 1, 1918; Lakeland, *T. G. Harbison 4, 13*, Aug. 1, 1918; Brookville, Hernando Co., *J. Kelley 21*, Sept., 1941. MISSISSIPPI: Biloxi, *T. G. Harbison 16*, May 6, 1918.

× **Quercus atlantica** Ashe (*Q. incana* × *obtusa*?), Proc. Soc. Amer. Foresters 11: 88. 1916. — Trelease, Mem. Nat. Acad. Sci. 20: 13. 1924.

× *Quercus dubia* Sargent, Bot. Gaz. 65: 452. 1918, in part, not Ashe.

Ashe described this as a new species but with the note that, "This tree might be considered a hybrid between *Quercus cinerea* and *Q. laurifolia*, but for the fact that both the fruit and the foliage are larger than in either of those species." But a careful reading of the description and an examination of Ashe's specimens from the type locality and other stations suggest that it is probably a cross between *Quercus incana* and *Q. obtusa*. All three species are found near the type locality. *Quercus obtusa* and *Q. laurifolia* are closely related and very similar species and it is not always

easy to distinguish between them. The same difficulty may be found in trying to identify hybrids in which they are involved, such as × *Quercus atlantica* and × *Q. sublaurifolia* discussed later. The best distinguishing characters between the species are that in *Quercus obtusa* the leaves are slightly larger on the average, usually broadened above the middle, rounded or obtuse at the apex, thinner in texture and earlier deciduous than in the laurel-oak; the acorns are also larger.

GEORGIA: Lumber City (Telfair Co.), *W. W. Ashe 10*, 1915 (TOPOTYPE), *T. G. Harbison 6*, May 30 and Dec. 15, *10*, *13*, May 30, and *15*, Dec. 16, 1917; Climax, *T. G. Harbison 11*, Nov. 6, 1917. FLORIDA: near Jacksonville, *A. H. Curtis* (without no. or date), *T. G. Harbison 4*, *5*, Dec. 7, *2*, *11*, *12*, Dec. 10, *23*, Dec. 3, 1917; Zellwood, *T. G. Harbison 3*, Dec. 4, 1917; Lake City, *T. G. Harbison 23*, June 23, 1917; Gainesville, *T. G. Harbison 160*, *164*, Dec. 4, 1917, *202*, Sept. 18, 1919.

× **Quercus Beadlei** Trelease[1] (*Q. alba* × *Prinus*), Proc. Amer. Phil. Soc. 56: 48. 1917; Mem. Nat. Acad. Sci. 20: 13. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 203. 1922.

Quercus alba × *Michauxii* Britton and Shafer, N. Amer. Trees 203. 1908.

Although no description was given and no type specimen was cited by Trelease, this hybrid was, no doubt, based on a specimen in the Biltmore Herbarium, no. 5723b, May 10 and Oct. 13, 1897. The earlier collection consisted of young leaves and flowers to which mature leaves and acorns were added in autumn. There seems to be no reason for questioning the parentage. The leaves are intermediate in shape between those of the parent species, with 6–12 pairs of rather uniform deeply divided lobes. While young they are coated beneath with pale, loosely attached tomentum, and at maturity they often become nearly glabrous except for tufts of tomentum in the axils and along the principal veins. The acorns of the type specimen and of most of the other fruiting specimens I have seen resemble those of *Quercus alba* in size and in the corky thickening of the scales of the cups, but in a specimen from Jackson Co., Indiana, they are quite similar to those of *Q. Prinus*. In this and another Indiana specimen the mature leaves are unusually pubescent beneath.

NEW JERSEY: near Newtonville, Atlantic Co., *J. W. Adams 4081*, Sept. 24, 1937. DELAWARE: Kiawense Station, near Wilmington (without date or name of collector). VIRGINIA: south of Seatack, *M. L. Fernald & Bayard Long 3902*, July 30, 1934. NORTH CAROLINA: Biltmore, ex Herb. Biltmore, no. *5723b*, May 10 and Oct. 13, 1897; swamps near Clarkton, Bladen Co., ex Herb. Biltmore, no. *5723c*, June 25, 1897. FLORIDA: rich woods east of Tallahasee, *R. M. Harper*, Dec. 6, 1924. INDIANA: 3 miles east of Mendora, Jackson Co., *C. C. Deam 19037*, Sept. 13, 1915; near Bedford, *R. M. Kriebel*, 1934. TEXAS: near Cleveland, San Jacinto Co., *C. H. Muller 3938*, July 11, 1941.

× **Quercus beaumontiana** Sargent (*Q. falcata* × *obtusa*), Bot. Gaz. 65: 451. 1918, (as *Q. rhombica* × *rubra*); Man. Trees N. Amer. ed. 2, 262. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 13. 1924, (as *Q.* [*laurifolia*] *rhombica* × *rubra*).

The type specimen of this hybrid was collected from a tree growing in low, native woods, in close association with the supposed parent species,

[1] Arbor foliis obovatis vel oblongo-obovatis plerumque satis profunde 13–25-lobatis maturis supra glabris infra pubescentibus interdum solum ad venulas.

and not from a street tree as stated in the description. The intermediate character of the generally slightly asymmetrically lobed leaves suggest the parentage.

TEXAS: Beaumont, *C. S. Sargent*, April 11, 1915 (planted along street), *E. J. Palmer 12748* (TYPE), Sept. 14, 1917, *13081*, March 16, 1918; Sauer Lake, Hardin Co., *E. J. Palmer 13109*, March 18, 1918.

× **Quercus Bebbiana** Schneider (*Q. alba* × *macrocarpa*), Ill. Handb. Laubh. 1: 201. 1904. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 13. 1924.

Quercus alba × *macrocarpa* Engelmann, Trans. Acad. Sci. St. Louis 3: 398. 1877. — Sargent, Silva 8: 18, pl. 360. 1894.

Specimens showing various degrees of transition between the parent species afford convincing evidence as to the hybrid origin and relationship of this plant.

CANADA: Ste. Anne de Bellevue, Que., *S. Baril*, Oct. 8, 1939. VERMONT: Charlotte, *C. G. Pringle*, Sept. 29, 1879. OHIO: Kenton, Hardin Co., *R. E. Horsey 720*, Sept. 27, 1918. INDIANA: Bedford, *R. M. Kriebel*, Oct. 1, 1932. MISSOURI: Hannibal, *J. Davis 3629*, Oct. 19, 1914; Swope Park (Kansas City), *B. F. Bush 9313, 9314*, Oct. 19, 1914, *E. J. Palmer 22323, 22324*, Oct. 21, 1922.

Also cultivated at the Arnold Arboretum and at Mt. Desert Nurseries, Bar. Harbor, Me. According to Schneider, this hybrid was first found by M. S. Bebb, near Fountaindale, Ill., but I have not seen the specimen.

(?) × **Quercus Benderi** Baenitz (*Q. borealis* × *coccinea*), Allg. Bot. Zeit. 9: 84. 1903, (as *Q. coccinea rubra*). — Sargent, Man. Trees N. Amer. ed 2, 248. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 13. 1924.

Believed to have originated spontaneously in cultivation. The hybrid origin of the plant is indicated, according to Baenitz, not only by the intermediate morphological characters and the yellow color of the autumn foliage, but also by a microscopic examination of the stamens and by the fact that the acorns are often sterile. A hybrid between two such similar species as the northern red oak and the scarlet oak would, obviously, be obscure and difficult to distinguish. An examination of the specimens distributed by Dr. Baenitz rather suggests *Quercus ellipsoidalis* E. J. Hill, a tree that was scarcely known as a distinct species in Europe at the time × *Q. Benderi* was published, although it might very well have found its way into cultivation without having been recognized. The small acorns with the nut half or more enclosed in the narrow, turbinate cup are very similar to those of the jack oak, and the leaves of both forms come within the range of variability shown in that species.

Besides the specimens collected by Baenitz in Scheitniger Park, Breslau, Silesia, in 1902, showing a seedling and mature leaves and acorns of the varieties and form, I have seen others with nearly fully grown leaves, collected by C. K. Schneider from the original trees, May 24–28, 1904. There is also a sheet in the Arnold Arboretum herbarium collected by A. Rehder, Blue Hills, near Boston, Mass., Sept. 22, 1900, and doubtfully referred to this hybrid. The specimen is sterile and the leaves look much like those of *Quercus borealis*. Hybrids between *Quercus borealis* and

Q. coccinea are not unlikely to be found where the two species grow in proximity, but I am somewhat doubtful as to whether × *Quercus Benderi* represents such a cross. It is perhaps best to leave the question open until fuller evidence is available.

× **Quercus bernardensis** W. Wolf (*Q. montana* × *stellata*), Torreya 18: 161. 1918.

Several trees of this apparent hybrid were found by Brother Wolf in the vicinity of Saint Bernard College, in Cullman County, northern Alabama, and they were believed by him to represent a new species. In the description he stated that *Quercus Prinus* (*montana*), its principal associate, was confined to the rocky slopes and cliffs, while × *Q. bernardensis* was found in a strip of lowland below the cliff. Other oaks mentioned as common in the vicinity were *Quercus alba*, *Q. stellata*, and *Q. velutina*. Trelease considered it a hybrid between *Quercus alba* and *Q. stellata* and therefore a synonym of × *Q. Fernowi*. The leaves are clearly intermediate in shape between those of the chestnut-oak and the post-oak, and the acorn in the one specimen in which they have been seen also indicate this relationship.

DISTRICT OF COLUMBIA: near Rock Creek, ex U. S. Nat. Herb., May 9, 1884. ALABAMA: St. Bernard, Cullman Co., *W. Wolf A*, April 28, May 14, May 24, and Oct. 26, 1918, *B*, Sept. 14, 1918, *D*, May 14, 1918, *F*, June 4, 1918; Cullman Co., *T. G. Harbison 4, 6*, Nov. 3, 1919; Valleyhead, *T. G. Harbison 26*, June 26, 1918; between Maud and Trio, Bibb Co., *R. M. Harper*, June 11, 1924.

× **Quercus bimundorum** hybr. nov. (*Q. alba* × *robur*).

Arbor ad 10–12 m. alt., foliis obovatis, profunde incisis lobis 7–9 obtusis apice obtusis basi leviter contractis subcordatis vel auriculatis; petiolis 5–10 mm. longis. Fructus ovatus 1.5–2 cm. longus pedunculatus; squamis cupulae rotundae paulis crassis.

A small tree that is apparently a spontaneous hybrid between the white oak and the English oak was found by C. H. L. Gebfert on a wooded hillside on the west side of Centre Street, Jamaica Plain, Mass. This tree was fruiting abundantly. Two trees of the same hybrid were discovered by J. C. Swartley on the farm of Charles Mann, near Horsham, Pennsylvania, and a specimen of one of them with mature leaves and fruit was sent to the Arnold Arboretum. According to information furnished by Mr. Mann and transmitted by Mr. Swartley, the trees were grown from seeds collected from a tree near a farmhouse on an extension of the Easton Highway, not far from Ivy Hill Cemetery. A large English oak was also found near the road and both the white oak and swamp white oak were growing in the vicinity. The name Syndenham Oak was proposed by Mr. Mann for these trees, in honor of some of his family connections. Another specimen collected in 1917 from a tree growing in the Harvard Botanical Garden at Cambridge, Mass., appears to belong to the same hybrid.

MASSACHUSETTS: Jamaica Plain, *C. H. L. Gebfert*, Sept. 3, 1923 (TYPE); Cambridge, Botanical Garden (cult.), *J. G. Jack*, Sept. 13, 1917. PENNSYLVANIA: near Horsham, Montgomery Co. (cult.), *J. C. Swartley S-858*, Oct. 10, 1936.

Mention was also made in the introduction of the cross having been made artificially (56).

× **Quercus blufftonensis** Trelease (*Q. falcata* × *laevis*), Proc. Amer. Phil. Soc. 56: 48. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 254, 1922.

The type of this is a sheet in the U. S. Nat. Herb., collected by J. H. Mellichamp at Bluffton, S. Car., Aug. and Oct., 1893. According to Trelease, it is very like × *Q. Mellichampi* except for its larger and thinner leaves. I have not seen the specimen nor any other material of this hybrid.

× **Quercus Brittoni** W. T. Davis (*Q. ilicifolia* × *marilandica*), Bull. Torrey Bot. Club 19: 301. 1892. — Sargent, Man. Trees N. Amer. ed. 2, 225. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 14. 1924.

Quercus nigra × *ilicifolia* W. T. Davis, Scientific American, Sept. 3, 1892; Proc. Nat. Sci. Assoc. Staten Isl., Sept. 10, 1892.

According to the author, a number of trees of this hybrid were found growing in sandy soil at Watchogue, on Staten Island, where both *Quercus ilicifolia* and *Q. marilandica* were abundant. Examination of material from the type locality and from several other stations furnishes convincing evidence of the validity of this hybrid.

NEW YORK: Watchogue, Staten Island, *W. T. Davis*, May 10 (and autumn), 1894. PENNSYLVANIA: Reading, Berks Co., *E. J. Palmer 36321*, Sept. 11, 1929; *David Berkheimer 4412*, Oct. 10, 1943. NEW JERSEY: Ocean Grove, *J. K. Hayward*, Sept., 1890.

(?) × **Quercus burnetensis** Little (*Q. macrocarpa* × *virginiana*), Jour. Washington Acad. Sci. 33: 9. 1943.

× *Quercus coloradensis* Ashe, Bull. Torrey Bot. Club 49: 268. 1922. Not Lesquereaux. 1888 (fossil).

The description of × *Quercus coloradensis* Ashe clearly indicates that the live oak is one of the parents, but there is little to suggest the bur-oak in any of the characters mentioned. I have not seen the type specimen nor any other material that can be referred to it. The type was collected along the Colorado River above Marble Falls, Texas.

× **Quercus Bushii** Sargent (*Q. marilandica* × *velutina*), Bot. Gaz. 65: 453. 1918; Man. Trees N. Amer. ed. 2, 259. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 14. 1924.

× *Quercus incomita* Palmer (as *Q. marilandica* × *rubra* [*falcata*]), Jour. Arnold Arb. 7: 120. 1926.

The type of × *Quercus Bushii* was collected near Sapulpa, Okla., and it has since been found at a number of other stations from Pennsylvania to South Carolina and westward to eastern Nebraska, eastern Kansas, and Mississippi. The intermediate characters of the leaves and fruit in the many specimens clearly indicate the parentage. In some specimens the young shoots are extremely vigorous and the winter-buds are larger than in either of the parent species. A further study of material from the type tree of × *Q. incomita* makes it seem probable that it may be of the same hybrid origin as × *Q. Bushii*, and it is accordingly treated as a synonym here.

PENNSYLVANIA: Reading, Berks Co., *E. J. Palmer 36308*, *36309*, Sept. 11, 1929, *David Berkheimer 4365*, Sept. 25, 1943, *5700*, Sept. 18, 1944. MARYLAND: near Lenham, Prince George Co., *W. R. Maxon 6009*, Aug. 31, 1914; 2 miles north of Harrisonville, Baltimore Co., *C. H. Muller 4963*, *4965*, *4966*, Oct. 12, 1941. NORTH

CAROLINA: Durham, *D. S. Correll 6896a*, Oct. 8, 1936. SOUTH CAROLINA: Spartansburg, ex Herb. Biltmore, no. *5723e*, Oct. 5, 1897. GEORGIA: Climax, *T. G. Harbison 7*, Nov. 6, 1917; Danielsville, Madison Co., *K. M. Wiegand & W. E. Manning 1045*, Aug. 18, 1921. NEBRASKA: Table Rock, Pawnee Co., *Thos. Howe*, Sept. 25, 1920. IOWA: Soap Creek, Davis Co., *Ada Hayden 9836*, June 26, 1939. INDIANA: Decker, Knox Co., *C. C. Deam 54322*, Aug 19, 1933, *54689*, Oct. 8, 1933, *R. M. Tryon 4262*, Sept. 3, 1939. ILLINOIS: southwest of Elbow, Richland Co., *Robt. Ridgway 3067*, July 22, 1928. TENNESSEE: Roan Co., *D. M. Coffman*, Oct. 3, 1889. MISSOURI: Buckner, *B. F. Bush 9706*, Oct. 3, 1921, *E. J. Palmer 22335*, Oct. 22, 1922; Holmes Park (Kansas City), *B. F. Bush 10368*, Oct. 22, 1924; Allenton, *G. W. Letterman*, July 28, 1911; Pertle Springs, Warrensburg, *E. J. Palmer 36747*, June 23, 1930; Prosperity, Jasper Co., *E. J. Palmer 15852*, Aug. 15, 1919; Joplin, Jasper Co., *E. J. Palmer 22735*, May 21, 1923. ARKANSAS: Eureka Springs, *E. J. Palmer 20509*, Sept. 17, 1921; Fayetteville, *E. J. Palmer 23950*, Oct. 1, 1923. KANSAS: Neodesha, Wilson Co., *E. J. Palmer 21379*, May 23, 1922. OKLAHOMA: Sapulpa, *B. F. Bush 1328* (TYPE), Sept. 20, 1895. MISSISSIPPI: Oxford, *T. G. Harbison 16*, Oct. 16, 1915.

× ***Quercus Byersi*** Sudworth ex Trelease (*Q. macrocarpa* × *Prinus*), Mem. Nat. Acad. Sci. 20: 14. 1924.

Quercus Michauxii × *macrocarpa* Sudworth, U. S. Dept. Agric., Div. Forestry, Bull. 14: 158. 1897.

The type was found near Covington, Tipton Co., Tennessee, associated with the bur-oak and the basket-oak, both of which are species of low or alluvial woods. I have not seen any specimens of this hybrid, but from the description and notes given by Sudworth there seems to be no reason to question the parentage.

× **Quercus caduca** Trelease (*Q. incana* × *nigra*), Proc. Amer. Phil. Soc. 56: 48. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 266. 1922.

Quercus cinerea × *aquatica* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 90. 1894.

Ashe stated that several trees of this hybrid were found, all near the coast, but no definite locality was given. I have not seen any of the original material; but there are a number of specimens in the herbarium of the Arnold Arboretum that have been referred to it. It is often difficult to distinguish between this hybrid and × *Quercus atlantica*, although there is a greater tendency for the leaves to be lobed or toothed near the apex than in the latter.

VIRGINIA: Cape Henry, Princess Anne Co., *M. L. Fernald & Bayard Long 4863*, Sept. 12, 1935. GEORGIA: Dorchester, *T. G. Harbison 23*, June 21, 1917; Folkston, *T. G. Harbison 71*, July 16, *90*, July 17, 1918; Lumber City, *T. G. Harbison 1*, May 30, Nov. 14, Dec. 16, 1917. FLORIDA: Gainesville, *T. G. Harbison 69*, *75*, July 25, 1918; Alachua County, *T. G. Harbison 101*, June 20, 1919; Sebring, *T. G. Harbison 62*, July 30, 1918. ALABAMA: Cottondale, *T. G. Harbison 41*, *44*, May 19, 1917. MISSISSIPPI: Mississippi City, *T. G. Harbison 8*, Oct. 28, 1917. TEXAS: Milano, Milam Co., *E. J. Palmer 11712*, April 27, 1917; Jacksonville, Cherokee Co., *E. J. Palmer 8597*, Sept. 21, 1915; Bryan, Brazos Co., *E. J. Palmer 10731*, *10748*, Sept. 17, 1916, *13474*, *13476*, April 27, 1918; Huntsville, Walker Co., *V. L. Cory 19524*, Sept. 11, 1936.

× **Quercus Capesii** W. Wolf (*Q. nigra* × *Phellos*), Castanea 10: 91, 120. 1945.

The description of this hybrid was based on variants that appeared in a planting of seedlings grown from acorns of a cultivated tree of *Quercus Phellos* growing in an assemblage of *Q. nigra* specimens at St. Bernard

College, Alabama. The two species grow together over most of their wide range in the southern states and what appear to be spontaneous hybrids between them have been found in several places. Hybridization seems also to have taken place among cultivated trees at other stations. The hybrid may be a relatively frequent one, but it is usually difficult to recognize it with certainty because of similarities of extreme forms of the parent species, especially in the leaves of shoots and juvenile specimens, which are often eccentrically lobed and quite similar in both, and they may sometimes be mistaken for hybrids.

NEW JERSEY: Cape May Co., *Bayard Long 7943*, Oct. 29, 1912. SOUTH CAROLINA: Calhoun Falls, *T. G. Harbison 19*, May 20, 1918. CULTIVATED: Hort. *C. S. Mann*, Hartsboro, Penn., *C. S. Sargent*, Sept. 13, 1914; Borde Hill, Sussex, England, *Stephensen R. Clarke*, May 18, 1933; La Maulevrie, Angers, France, *Antoine de Cugnac*, Sept., 1922.

(?) × **Quercus Cocksii** Sargent (*Q. obtusa* × *velutina*), Bot. Gaz. 65: 459. 1918; Man. Trees N. Amer. ed. 2, 262. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 14. 1924.

The only material that I have seen of this hybrid is the type collection of two sheets, *R. S. Cocks 4702*, Pineville, La., April 18, 1917.

The specimens have young but nearly fully grown leaves and pistillate flowers. The leaves are mostly 7 to 15 cm. long and 2 to 6 cm. broad, lanceolate or rhombic in outline, with nearly entire, undulate or eccentrically lobed margins. There is no doubt that the plant is a hybrid, and the shape of the leaves indicates *Quercus obtusa* as one of the parents; but the character of the pubescence on the under surface of the leaves rather suggests *Q. falcata* as the other parent, and if that is the case, it would be a synonym of × *Q. beaumontiana*. But in the absence of fruit it is perhaps best to leave it among the doubtfully authenticated hybrids.

× **Quercus Comptonae** Sargent (*Q. lyrata* × *virginiana*), Bot. Gaz. 65: 456. 1918; Man. Trees N. Amer. ed 2, 293. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 14. 1924.

Quercus lyrata × *virginiana* H. Ness, Jour. Heredity 9: 265, fig. 6–8. 1918. — Yarnell, Jour. Arnold Arb. 14: 68. 1933.

This is one of the most interesting of the hybrid oaks both on account of its striking characters derived from the very distinct parent species, and because of the fact that it has been found growing spontaneously at several stations and has also been produced artificially under conditions that have permitted careful study. It is a handsome and ornamental tree of rapid growth and should be valuable in cultivation. Although the live oak is not hardy in this latitude and the overcup oak though hardy is far north of its native range, several seedlings of the hybrid grown from acorns sent by Miss Compton from Mississippi grew for several years in the Arboretum until lost by fire injury.

VIRGINIA: Williamsburg (planted on Courthouse Green, but transplanted from Virginia Beach where it was found spontaneous), *J. T. Baldwin, Jr. 5612*, Jan. 20, 1947. ALABAMA: Selma, ("at old house on plantation"), *T. G. Harbison 10*, April 20 and Oct. 21, 1915. MISSISSIPPI: Natchez, *Miss C. C. Compton*, many collections under nos. *12*, *16*, *18*, *19*, *26*, *27*, *28*, *29*, *32*, *33*, *34*, *35*, *38*, *39*, *43*, *44*, *45*, and *47*, in

1915 and 1916, *C. S. Sargent*, April 17, 1915, April 16, 1916. LOUISIANA: New Orleans, *R. S. Cocks*, Oct., 1911, *C. S. Sargent*, Audubon Park, March 31, 1917. TEXAS: along Payson's Creek, Matagorda Co., *C. H. Mohr 96*, Dec. 18, 1880.

A number of specimens from cultivated plants are also in the herbarium of the Arnold Arboretum, including several of the Ness hybrids grown at College Station, Texas, others grown here from acorns sent by Professor Ness and Miss Compton, and one from a small tree on the campus of the University of Kentucky, Lexington, Ky., that is said to have come originally from western Louisiana.

× **Quercus cravenensis** Little (*Q. incana* × *marilandica*), Jour. Washington Acad. Sci. 33: 9. 1943.

× *Quercus carolinensis* Trelease, Proc. Amer. Phil. Soc. 56: 48. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 266. 1922. Not. *Q. carolinensis* Muench. 1770.

Quercus cinerea × *nigra* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 91. 1894.

Trelease gave no description and did not cite a type specimen when the name × *Quercus carolinensis* was published. But Ashe's notes on the plants and collections on which it was evidently based give a good idea of the hybrid. He stated that perhaps ten trees were seen, all in the neighborhood of the coast. I have not seen the original material, but several specimens in the herbarium of the Arnold Arboretum seem clearly to represent it. In typical specimens the pubescence and veining of the leaves show the relationship to *Quercus marilandica* and some of them have the subcordate base and short petioles characteristic of that species. The branchlets are generally stout and stiff, which is also a character of the black jack oak; but in other specimens the branchlets are more slender and the general shape of the leaves with long petioles and cuneate bases more nearly resembles the other parent.

VIRGINIA: south of Franklin, Southampton Co., *M. L. Fernald & Bayard Long 8242*, June 19, 1938 (G). NORTH CAROLINA: Carolina Beach, New Hanover Co., *R. H. Gorfry 6241*, Aug. 28, 1938 (G); New Berne, *T. G. Harbison 27, 48*, Oct. 9, 1917. SOUTH CAROLINA: Seneca, *T. G. Harbison 6083*, April 29, 1922; Myrtle Beach, *Ludlow Griscom 16513*, April 24, 1932. GEORGIA: Lumber City, *T. G. Harbison 3*, May 29, *4*, May 8, and *1*, Nov. 15, 1917; Climax, *T. G. Harbison 3*, May 29, *8*, *10*, Nov. 6, 1917. ALABAMA: Spring Hill, *T. G. Harbison 5861*, March 27, 1920. TEXAS: Fletcher, Hardin Co., *E. J. Palmer 12741*, Sept. 12, 1917.

(?) × **Quercus Deami** Trelease (*Q. alba* × *Muhlenbergii*), Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922. — Deam, Fl. Indiana 384. 1940.

Quercus alba × *Muhlenbergii* Deam, Rept. Ind. Bd. Forestry, Bull. 2: 127. 1912.

In proposing the name × *Quercus Deami* for this hybrid Trelease referred to Deam's description and plate (22). The fine original tree on which it was based is now preserved as a state monument near Bluffton, Ind. It was believed to be a hybrid between *Quercus alba* and *Q. Muhlenbergii*, and was so determined by G. B. Sudworth. The leaves have more resemblance to those of *Quercus alba* in outline than to those of the other supposed parent, and they are pale and finely pubescent on the under surface. Some doubt has been thrown on the parentage by the fact that

seedlings raised at the Arnold Arboretum from acorns supposed to have come from the type tree have leaves similar to those of *Quercus bicolor*. Should it be found that the tree is really a cross between *Quercus alba* and *Q. bicolor*, the name would have to be regarded as a synonym of × *Quercus Jackiana*. But since there may be a possibility of error in the record, it seems best to suspend judgment until there is more evidence. Irrespective of the parentage of the original plant, some of the collections enumerated below are probably crosses between *Quercus alba* and *Q. Muhlenbergii*.

PENNSYLVANIA: Waterside, Bedford Co., *David Berkheimer 5486*, Aug. 21, 1944. INDIANA: 3 miles northwest of Bluffton, Wells Co., *C. C. Deam 14117*, Sept. 28, No. *14131*, Oct. 5, 1913, No. 22100, Sept. 24, 1916, No. *49948*, Sept. 22, 1930 (all from the type tree). ILLINOIS: New Haven, White Co., *E. J. Palmer 15298*, May 28, 1919. KENTUCKY: Litchfield, Grayson Co., *W. W. Eggleston 5444*, Oct. 11, 1909 (G).

× **Quercus Demarei** Ashe (*Q. nigra* × *velutina*), Jour. Elisha Mitchell Sci. Soc. 41: 268. 1926.

Quercus nigra × *velutina*? Palmer, Jour. Arnold Arb. 7: 119. 1926.

I have not seen the type specimen, but several collections in the herbarium of the Arnold Arboretum seem to be hybrids between the water-oak and the black oak.

ARKANSAS: Boto, Pike Co., *D. Demaree 9395*, Sept. 29, 1932; Craighead Co., *D. Demaree 7180*, Sept. 18, 1929; Hot Springs, Garland Co., *E. J. Palmer 26858*, April 22, *27117*, May 19, 1925. LOUISIANA: Natchitoches, *E. J. Palmer 7473*, May 3, 1915.

× **Quercus Egglestoni** Trelease (*Q. imbricaria* × *Shumardii*), Mem. Nat. Acad. Sci. 20: 14. 1924.

× *Quercus Shirlingii* Bush ex Palmer & Steyerm. (*Q. imbricaria* × *Shumardii* var. *Schneckii*), Ann. Missouri Bot. Gard. 22: 521. 1935.

Trelease's brief description of × *Quercus Egglestoni* says: "Very like × *Q. runcinata* but with thicker leaves, the clay-colored or reddish buds intermediate between those of *maxima* and *Shumardii*." In giving the parentage he placed a question mark after *Q. imbricaria*. In the type specimen the leaves are deeply divided with sharp nearly simple symmetrical lobes, much more like those of *Q. Shumardii* than of the other suggested parent. The acorns are short-ovate to subglobose, 1.5–1.7 cm. long, with shallow cups enclosing about ¼ of the nut, and small closely imbricated glabrous scales, and they are somewhat intermediate between those of the suggested parents. If the name is accepted, it would have priority over × *Q. Shirlingii*, as I do not think it possible to determine which variety of *Q. Shumardii* is involved in such a hybrid.

KENTUCKY: Litchfield, Grayson Co., *W. W. Eggleston 5444*, Oct. 11, 1909 (G). MISSOURI: Oak Grove, *B. F. Bush 11637*, Oct. 22. 1927.

× **Quercus Eplingi** C. H. Muller (*Q. Douglasii* × *Garryana*), Amer. Midl. Naturalist 19: 585. 1938.

The type specimen was collected by Epling and Robinson, Lake Co., California, July 27, 1935, and is deposited in the herbarium of the University of California, Los Angeles, Calif. I have not seen any material referable to it.

× **Quercus exacta** Trelease (*Q. imbricaria* × *palustris*), Proc. Amer. Phil. Soc. **56**: 49. 1917; Mem. Nat. Acad. Sci. **20**: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 268. 1922.

Quercus imbricaria × *palustris* Engelmann ex A. Braun, Sitzungsber. Gesellsck naturf. freunde Dec. 20, **1870**: 82. 1871; Bot. Zeit. **29**: 202. 1871. — Engelmann, Trans. Acad. Sci. St. Louis 3: 400. 1877.

It is sometimes difficult to distinguish sterile specimens of this hybrid from × *Q. runcinata*. As compared with the latter, the leaves are inclined to be somewhat smaller and thinner in texture and to have fewer primary veins and more persistent tomentum in the axils of the veins and along the midrib. But all of these characters are variable and some specimens may be doubtful.

PENNSYLVANIA: Finland, Bucks Co., *Bayard Long 18719*, May 23, 1918 (G). INDIANA: near Half Moon Pond, Posey Co., *C. C. Deam 29116*, Aug. 16, 1919. ILLINOIS: near Olney, Richland Co., *Robt. Ridgway 33, 34*, Aug. 18, 1914, *1488*, Sept. 29, 1921, *C. S. Sargent*, Oct. 5, 1913, *E. J. Palmer 22625*, May 15, 1923; Gentry Creek, Richland Co., *Robt. Ridgway 27*, Sept. 9, 1918; (East St. Louis?), *George Engelmann*, 1870 (G).

× **Quercus fallax** nom. nov.

Quercus macrocarpa × *Muhlenbergii* Hitchcock, Bot. Gaz. 18: 110–111, pl. 8. 1893. — Bush, Garden and Forest 8: 32. 1895. — Sargent, Silva 8: 56. 1895.

Arbor foliis obovatis vel lanceolato-obovatis 8–24 cm. longis 4–12 cm. latis dentato-lobatis subtus pallidis plene minute pubescentibus. Fructus oblongo-obovatus 2–3 cm. longus et latus; glande in cupulo rotundo circiter $\frac{1}{2}$ incluso, squamis cupulae acuminatis crassis pubescentibus.

Trelease proposed the name × *Quercus Hillii* for a hybrid that was supposed to have arisen between the two species mentioned above. Although no description was given and no type specimen cited, it is evident from the name and from a reference to a note in Sargent's Silva that it was based on a collection of E. J. Hill, near Roby, Indiana. But an examination of a sheet of Hill's collection in the herbarium of the Arnold Arboretum convinces me that it is really a hybrid between *Quercus bicolor* and *Q. macrocarpa*, a combination that was described later in the same paper by Trelease as × *Quercus Schuettei*. If that is the case, × *Quercus Schuettei* must be regarded as a synonymn of the earlier name, and it is necessary to adopt a new name for the real hybrid between *Quercus macrocarpa* and *Q. Muhlenbergii*.

Professor A. S. Hitchcock (28) reported finding this hybrid near Manhatten, Kans., in 1893, and Mr. B. F. Bush (13) gave an account of two trees found near Independence, Mo., in 1895. I have not seen Hitchcock's collection, but the description and the figure that accompanied it show a plant very similar in foliage to *Quercus macrocarpa*. The fruit was described as intermediate between that of the parent species. In the specimen that is taken here as the type of × *Quercus fallax* and in other collections by Bush the leaves are clearly intermediate between those of the bur-oak and the chinquapin-oak. The fruit is nearly as large as the average in the bur-oak.

MISSOURI: Independence, Jackson Co., *B. F. Bush 621*, Sept. 11, *625*, Sept. 16, 1894, *626*, Oct. 14, and *629* (TYPE), Oct. 7, 1895; Swope Park (Kansas City), *B. F. Bush 10326*, Oct. 6, 1923.

× **Quercus Faxoni** Trelease (*Q. alba* × *prinoides*), Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922.

There seems to be no reason to question the parentage of this hybrid although it may be difficult in some cases to distinguish sterile specimens from forms of × *Quercus Saulei*.

MASSACHUSETTS: East Walpole, *J. G. Jack 1*, Sept. 17, 1914, May 28, 1915, June 1, 1916, May 31, 1926, No. 2952, May 25, 1931. NEW YORK: Albany, *H. D. House 20137*, Sept. 2, 1932 (G).

× **Quercus Fernaldi** Trelease (*Q. borealis* × *ilicifolia*), Mem. Nat. Acad. Sci. 20: 15. 1924.

The parentage of this hybrid was given by Trelease as *Q. ilicifolia* × *maxima*, but in this writer's opinion, *Q. borealis* and *Q. maxima*, so-called, are only forms of varieties of one species, and it is generally impossible to tell which of them is involved in a hybrid. Sargent proposed the name × *Quercus Lowellii* (53) for a supposed hybrid between *Quercus borealis* and *Q. ilicifolia*. But an examination of the type, which was a sterile shoot, led Trelease to suggest that perhaps it was only an aberrant form of *maxima* or *borealis;* and I believe that he was correct in his opinion and that × *Quercus Lowellii* must therefore be considered a synonym of *Q. borealis*.

MASSACHUSETTS: Sharon, summit of Moose Hill, *J. G. Jack 3818*, *3819*, June 20, 1926; East Walpole, *J. G. Jack 3954*, Sept. 13, 3955, Sept. 20, 1931, *1*, *2*, *3*, May 15, 1936. VIRGINIA: Little Stony Mountain, Madison Co., *H. A. Allard*, Sept. 23, 1933 (G).

× **Quercus Fernowi** Trelease (*Q. alba* × *stellata*), Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 15. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922.

Quercus alba × *stellata* Engelmann, Trans. Acad. Sci. St. Louis 3: 399. 1877. — Vasey, Bull. Torrey Bot. Club 10: 25, pl. 29–30. 1883. — Sargent (as *alba* × *minor*), Silva 8: 18, pl. 359. 1895.

NEW JERSEY: Browns Mills, Burlington Co., *J. C. Swartley 429*, Aug. 24, 1935. VIRGINIA: Red Clay Creek, *C. S. Sargent*, Oct. 6, 1891; northwest of Suffolk, Nansemond Co., *M. L. Fernald & Bayard Long 13321*, July 23, 1941 (G); Beverley Hill to High Point, Fauquier Co., *H. A. Allard 9794*, Oct. 26, 1941 (G); Bull Run Mountains, Fauquier Co., *H. A. Allard 9944*, May 17, 1942 (G). DELAWARE: Marshallton, *J. P. Otis*, Oct. 1923. MARYLAND: near Beltsville, *L. P. McCollough*, Oct., 1943. INDIANA: southeast of Nashville, Brown Co., *C. C. Deam 56933*, Oct. 10, 1935. MISSOURI: Allenton, *G. W. Letterman*, May 10, 1882, Oct., 1883, April 30, July 10, 1884, Oct., 1890, *C. S. Sargent*, Aug. 26, 1894, *J. H. Kellogg*, Oct. 12, 1907, Oct. 5, 1910, *25978*, June 14, 1932. TEXAS: Milano, Milam Co., *E. J. Palmer 11658*, April 24, 1917.

× **Quercus filialis** Little (*Q. Phellos* × *velutina*), Jour. Washington Acad. Sci. 33: 10. 1943.

× *Quercus inaequalis* Palmer & Steyermark, Ann. Missouri Bot. Gard. 22: 521. 1935. Not *Q. inaequalis* Watelet. 1866 (fossil).

× *Quercus dubia* Trelease, Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. Not Ashe.

In his first paper on the hybrid oaks (64) Trelease gave the parentage of × *Quercus dubia* Ashe as *Phellos* × *?velutina*, and the same doubtful disposition of it was made in the Monograph of American Oaks, but in the latter work he suggested that *Q. laevis* might be one of the parents, and he also remarked that the type collection is very like the entire leaved form of × *Q. Rudkini*, which it may represent. Sargent considered × *Q. dubia* a hybrid between *Q. laevis* (*cinerea*) and *Q. laurifolia* — a wide divergence of opinion — , and it would seem that the name was well chosen. There is a large series of specimens under the name × *Quercus dubia* in the herbarium of the Arnold Arboretum, including several sheets collected and named by Ashe, as well as others that he called × *Q. atlantica* and one that was given the manuscript name of × *Q. bladenensis*. A careful examination of this material leads me to believe that more than one and perhaps three or four hybrids are represented. But none of them suggest a cross between the willow-oak and the black oak. Certainly *Quercus laurifolia* is one of the parents in most cases, and there can be little doubt that *Q. laevis* is involved in many of them. And a few sheets can probably be referred to × *Q. Rudkini* as suggested by Trelease.

× *Quercus filialis* has frequently been confused with × *Q. heterophylla* which it resembles closely in the shape of the variable leaves. It can be distinguished from that hybrid by the more persistent tomentum on the under surface of the leaves, especially along the principal veins and in their axils, and by its generally larger winter-buds with pubescent scales. The acorns when present are distinguishable by the looser pubescent scales of the cups.

NEW JERSEY: Woodbury, *Isaac C. Martindale*, Sept., 1876; Belleplain State Forest, Cape May Co., *H. A. Scribner*, Aug. 2, 1939; Mt. Holly, *S. P. Sharples*, Sept. 6, 1881. DELAWARE: Wilmington, *A. Commons*, Sept. 29, 1876, Sept. 16, 1877 (G). MISSOURI: Poplar Bluff, *E. J. Palmer 16342* (type of *Q. inaequalis*), Sept. 11, 1919, *20676*, Oct. 5, 1921. ARKANSAS: Hardinville, Faulkner Co., *E. J. Palmer 26505*; Conway, Faulkner Co., *D. Demaree 13812*, Oct. 2, 1936; Hot Springs, *E. J. Palmer 29098*, Oct. 10, 1925, *29577*, Nov. 5, 1925. LOUISIANA: Plains, East Baton Rouge Parish, *Clair A. Brown 9904*, Oct. 13, 1943. Cultivated in the Arnold Arboretum.

× **Quercus Ganderi** C. B. Wolf (*Q. agrifolia* × *Kelloggii*), Proc. Calif. Acad. Sci. ser. 4, 25: 178, pl. 18–19. 1944.

A full description with numerous figures of the leaves and fruit accompanied the publication of this name. There were also notes on a number of trees discovered in San Diego Co., Calif., and on results obtained with seedlings grown from acorns of the type tree. Another collection was mentioned from Monterey County that may be of similar hybrid origin. The formula of parentage given by the author was, *Quercus Kelloggii* Newb. × *Quercus agrifolia* var. *oxyadenia* (Torr.) J. T. Howell.

CALIFORNIA: between Santa Ysabel and Lake Henshaw, San Diego Co., *C. B. Wolf 9487*, Jan. 24, 1939, *C. B. Wolf* & *P. C. Everett 9483*, Jan. 10, 1939, *9543* (ISOTYPE), Oct. 20, 1939; from Mesa Grande on road to Lake Henshaw, San Diego Co., *C. B. Wolf 9488*, *9489*, Jan. 24, 1939; south of Marettis on road to Santa Ysabel, San Diego Co., *C. H. Muller 4034*, Aug. 9, 1941.

× **Quercus garlandensis** Palmer (*Q. falcata* × *nigra*), Jour. Arnold Arb. 7: 119. 1926 (as *nigra* × *rubra*).

The description of this hybrid was based on material from two trees found near Hot Springs, Ark. Both supposed parents were growing in the immediate vicinity; and the intermediate characters of the foliage, fruit, bark, and winter-buds indicate the relationship. The leaves are extremely variable in shape and size, many of them being asymmetric; and the loose pale or tawny pubescence of the young leaves is significant. A few additional trees have been found in other localities.

ARKANSAS: Hot Springs, *E. J. Palmer 23139*, July 7, *24237*, *24328*, Oct. 20, 1923, *24455*, *24456*, April 22, 1924, *26856*, *26857*, April 22, *29223*, Oct. 14, *29573*, *29574*, Nov. 5, 1925; Langley, Pike Co., *D. Demaree 9515*, Oct. 5, 1932. ALABAMA: Sardis, *R. S. Cocks 4704*, Sept. 25, 1917; Berlin, *R. S. Cocks*, Aug., 1917; Mt. Vernon, *T. G. Harbison 8*, May 19, 1917. LOUISIANA: Pineville, *R. S. Cocks 4702*, Oct. 3, 1917.

× **Quercus Giffordi** Trelease (*Q. ilicifolia* × *Phellos*), Proc. Amer. Phil. Soc. **56**: 49. 1917; Mem. Nat. Acad. Sci. **20**: 15. 1924. — Sargent, Man. Trees. N. Amer. ed. 255. 1922.

An isotype in the herbarium of the Arnold Arboretum consists only of a sterile shoot and several detached leaves. The outlines of the undulate or irregularly lobed leaves and the fine cinereous pubescence on their under surface seem to confirm the suggested parentage. The specimens from Delaware are much better, and some of them have mature fruit.

NEW JERSEY: May's Landing, *J. C. Gifford & J. E. Peters*, July 11, 1890 (ISOTYPE). DELAWARE: near Dover, *C. S. Sargent*, Oct. 10, 1922; Wilson Station, *J. T. Otis*, 1922; near Marshallton, *J. T. Otis*, Sept. 18, 1923.

× **Quercus guadalupensis** Sargent (*Q. macrocarpa* × *stellata*), Bot. Gaz. **65**: 454. 1918; Man. Trees N. Amer. ed. 2, 291. 1922. — Trelease, Mem. Nat. Acad. Sci. **20**: 15. 1924.

Although only material from the type tree is known, it is so complete and the leaves and fruit are so clearly intermediate between those of the parent species that there can be no doubt as to its origin. Both the bur-oak and the post-oak were found growing near the type tree.

TEXAS: Fredericksburg Junction, Kendall Co., *E. J. Palmer 10878* (TYPE), Oct. 1, 1916.

× **Quercus Harbisonii** Sargent (*Q. stellata* × *virginiana*), Bot. Gaz. **65**: 458. 1918 (as *stellata* var. *Margaretta* × *virginiana* var. *geminata*); Man. Trees N. Amer. ed. 2, 295. 1922. — Trelease, Mem. Nat. Acad. Sci. **20**: 15. 1924 (as *geminata* × *Margaretta*).

× *Quercus neo-tharpii* A. Camus (as *Durandii* × *virginiana*), Les Chênes **2**: 754. Atlas **2**: pl. 226, fig. 9–19. 1939.

Although Sargent described × *Quercus Harbisonii* as a hybrid between botanical varieties of the post-oak and live oak, other specimens have been found that show evidences of being crosses between the typical forms of these species, and I can see no way of distinguishing them. If *Quercus geminata* and *Q. Margaretta* were regarded as distinct species, as was held by Trelease and others, the name × *Quercus Harbisonii* would technically have to be restricted to a cross between them and it would be necessary to adopt another name for the *Q. stellata* × *virginiana* hybrid. Besides

several spontaneous specimens of apparent crosses between typical forms of the post-oak and live oak, it has been produced by artificial cross-pollination, as mentioned in the introduction.

Specimens of Tharp's collections from the coast of Texas that were cited and illustrated by Camus as believed to be a hybrid between *Quercus Durandii* and *Q. virginiana* are in the herbarium of the Arnold Arboretum. Except for a superficial resemblance in the shape of some of the leaves, I can see no suggestion of *Quercus Durandii* parentage in them. The fruit closely resembles that of *Q. virginiana*, but it is large and with deep cups even for that species. The scurfy stellate pubescence on the under surface of the mature leaves and on the branchlets suggests *Q. stellata* as the other parent.

FLORIDA: Jacksonville, *T. G. Harbison 16*, Dec. 3, 1917 (TYPE). TEXAS: Ft. Chadburn, Coke Co., *E. J. Palmer 12463*, July 9, 1917; Roby (Fisher Co.), *B. C. Tharp 4238*, Aug. 16, 1926; between Seadrift and Port O'Connor, *B. C. Tharp 8768-a*, Dec. 1, 1928, *8768-b*, March 20, 1930; College Station (artificial hybrids, cultivated), *H. Ness*, 1922, and *W. S. Flory Jr.*, 1943.

(?) × **Quercus Hastingsii** Sargent (*Q. marilandica* × *Shumardii*), Bot. Gaz. **65**: 450. 1918; Man. Trees N. Amer. ed. 2, 259. 1922 (as *Q. marilandica texana*).

The leaves of the type, except in their fewer shallow and blunt lobes, are much nearer in appearance to those of *Quercus Shumardii* var. *texana* than to those of the other supposed parent, and Trelease held that it was apparently scarcely more than a form of *Q. texana*. But there are indications of hybrid origin and of the influence of *Q. marilandica* in the stiff branchlets, pubescent through the first year, and in traces of pubescence on the petioles, the under surface of the leaves, cup scales, and scales of the winter-buds. Specimens found at Brownwood, Texas, more nearly resemble *Q. marilandica* var. *Ashei* Sudw. in the shape of the leaves and in the stiff habit and dark rough bark. The supposed hybrids have all been found in the vicinity of *Q. Shumardii* var. *texana* and *Q. marilandica* or the variety *Ashei*, growing under xerophytic conditions. Should hybrids be found between the typical varieties of the two species, they might differ rather widely from × *Quercus Hastingsii* as found in Texas.

TEXAS: near Bourne, *S. H. Hastings 145* (TYPE), Oct., 1910; Brownwood, *E. J. Palmer 10364*, July 5, 1916, *13056*, Oct. 18, 1917, *26818*, Nov. 1, 1924, *29547*, *29548*, Nov. 2, 1925.

× **Quercus Hawkinsii** Sudworth (*Q. borealis* × *velutina*), Amer. Forestry **23**: 685, fig. 1, 2, 5. 1917.

Quercus Porteri Trelease, Proc. Amer. Phil. Soc. **56**: 51. 1917 (*nomen* nudum); Mem. Nat. Acad. Sci. **20**: 16. 1924.

In publishing the description of × *Quercus Hawkinsii* with full notes and figures, Sudworth gave his reasons for believing that it was a hybrid between *Quercus borealis* and *Q. velutina*. But he also suggested the possibility that *Quercus palustris* might be one of the parents. The acorns figured certainly resemble those of the pin-oak, but the leaves and bark are more like those of the black oak. If, as seems probable, the parentage was correctly determined, the name has priority over × *Quercus Porteri*.

For although Trelease's first publication of the name × *Quercus Porteri* was a few months earlier, the description of × *Q. Hawkinsii* appeared first.

Trelease in his Monograph of American Oaks accepted *Quercus borealis* and *Q. maxima* as distinct species, and he gave the parentage of × *Q. Porteri* as *Q. maxima*? × *velutina*. He also inserted the name × *Quercus Hawkinsii* with the parentage, *Q. borealis* (*maxima*) × *velutina*, but with the note: "Scarcely differs from *maxima* except in its yellow cotyledons."

The leaves of the northern red oak and the black oak are generally quite similar in shape, and a hybrid between them is not outstanding or easily distinguished in foliage specimens. The only notable distinction between the typical form of *Quercus borealis* and the variety *maxima* is in the shape of the acorn cups, and, in my opinion, it would generally be impossible to determine which variety is involved in a hybrid. The best characters for distinguishing × *Quercus Hawkinsii* from *Q. borealis* are found in the somewhat pubescent scales of the winter-buds and in the more persistent tomentum on the under surface of the leaves. If acorns are available, they are likely to show characters of the black oak in the shape of the cup or in the pubescence of its inner surface and scales.

MAINE: Lyman, York Co., *F. Hyland 162*, July 24, 1934. MASSACHUSETTS: Jamaica Plain, *J. G. Jack 3803*, Nov. 2, 1925; Dedham, *J. G. Jack 3839*, Oct. 15, 1926. NEW YORK: Durand-Eastman Park, Rochester, *B. H. Slavin 6*, Oct. 12, 1918. PENNSYLVANIA: Easton, *Thos. C. Porter*, Sept. 30, 1893, May 12, 1894. OHIO: Lakeside, Ottawa Co., *W. A. Kellerman 63*, May 17 and Sept. 16, 1900. MISSOURI: Swope Park (Kansas City), *Kendall Laughlin*, 1938; Holmes Park (Kansas City), *B. F. Bush 9944*, Oct. 9, 1922, *E. J. Palmer 22327*, Oct. 21, 1922; Dumas, Clark Co., *E. J. Palmer 21904*, Sept. 8, 1922, *B. F. Bush 9528*, Aug. 29, 1921; Crowleys Ridge, Dunklin Co., *J. H. Kellogg 26043*, Aug. 7, 1932. This hybrid is also in cultivation in the Arnold Arboretum, and specimens grown from seeds have retained the intermediate characters.

× **Quercus heterophylla** Michx. f. (*Q. borealis* × *Phellos*), Hist. Arb. Amer. Sept. 2: 87, pl. 16. 1812; N. Amer. Silva (English ed.) 1: 75, pl. 18. 1819. — Gale, Proc. Nat. Inst. 1875: 70, fig. 1. 1875. — Sargent, Silva 8: 456, pl. 436. 1895; Man. Trees N. Amer. ed. 2, 263, fig. 241. 1922. — Trelease, Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 15. 1924.

This classic example of a spontaneous hybrid oak has been figured and described many times. A discussion will be found in the introduction to this paper.

NEW YORK: Tottenville, Staten Island, *Arthur Hollick*, Sept. 2, 1888, *J. K. Small*, Aug. 2, 1890, *C. S. Sargent*, Aug. 6, 1894. PENNSYLVANIA: Hatboro, *C. S. Mann*, Oct., 1918; Upper Darby, *Joseph Crawford*, Aug. 30, 1909; Finland, *W. A. Kline*, July and Nov. 3, 1917. NEW JERSEY: Mickleton, Gloucester Co., *B. Heritage*, Oct. 22, 1895; Gloucester Co., *C. A. Gaskell*, Aug. 1914; State Game Farm, Ocean Co., *Hollis Koster*, June 30, 1937; Buss River State Forest, Burlington Co., *Hollis Koster*, May 13 and Oct. 3, 1934; Westville, *J. W. Adams 4186*, Nov. 2, 1937; South Westville, *J. W. Adams 4562*, Oct. 21, 1938; Mullica Hill, Gloucester Co., *J. W. Adams 4853*, Oct. 10, 1939. DELAWARE: Hazlettville, *J. P. Otis*, 1922; Marshallton, *J. P. Otis*, Sept. 18, 1923. MISSOURI: northwest of Wappapelo, Wayne Co., *Julian A. Steyermark 6428*, Sept. 2, 1938; Crowleys Ridge, Dunklin Co., *J. H. Kellogg 26039*, Aug. 7, 1932. ARKANSAS: Corning, *G. W. Letterman 4*, Oct. 1882. OKLAHOMA: Page, Le

Flore Co., *E. J. Palmer 20901*, April 22, *21597*, May 30, *22232* Oct. 7, 1922. Specimens have also been examined from trees cultivated in the Arnold Arboretum and in a number of other botanic gardens and parks, including seedling plants grown from cuttings from the original tree.

× **Quercus Hillii** Trelease (*Q. bicolor* × *macrocarpa*), Proc. Amer. Phil. Soc. 56: 49. 1917 (as *macrocarpa* × *Muhlenbergii*); Mem. Nat. Acad. Sci. 20: 15. 1924. — Sargent, Silva 8: 56. 1895; Man. Trees N. Amer. ed. 2, 292. 1922. — Deam, Fl. Indiana, 384. 1940.

× *Quercus Schuettei* Trelease, Proc. Amer. Phil. Soc. 56: 51, pl. 2–3. 1917.

The synonomy was discussed under description of × *Quercus fallax*. × *Quercus Hillii*, as here understood, seems to be a relatively abundant and widely distributed hybrid, since the parent species are rather closely related and grow together in similar habitats over a large area. The leaves of both species are quite variable in shape, but those of the bur-oak (*Q. macrocarpa*) are usually larger, more deeply lobed and with a looser less persistent pubescence than in *Q. bicolor*. Leaves of the hybrid show intermediate characters, but fruit may be necessary to make determination certain in some cases.

CANADA: Montreal, near Rockfield, *J. G. Jack*, Aug. 17, 1894; Chateaugay, *J. G. Jack*, Sept. 16, 1911, Aug. 15, 1895, Sept. 7, 1896; Longueuil, *M. Victorin 16477*, Sept., 1922. NEW YORK: Golah (Monroe Co.), *J. Dunbar*, Sept. 28, 1915, Sept. 23, 1922; Mumford, Monroe Co., *B. H. Slavin 47*, Sept. 27, 1922. INDIANA: Roby, (Lake Co.), *E. J. Hill*, May 12 and 27, June 27, 1892 (TYPE). Cultivated, Arnold Arboretum, Municipal Parks, Rochester, N. Y., and elsewhere in America and Europe.

× **Quercus humidicola** Palmer (*Q. bicolor* × *lyrata*), Jour. Arnold Arb. 18: 140. 1937.

The swamp white oak and the overcup oak, both trees of low wet woods, are often found growing together in regions where their ranges overlap. The leaves and fruit of the two species are quite different, and hybrids are rather easily recognizable by their intermediate characters.

ILLINOIS: Mounds, Pulaski Co., *E. J. Palmer 16634*, Oct. 1, 1919, *19546*, Oct. 16, 1920; Mound City, Pulaski Co., *E. J. Palmer 16642*, Oct. 1, 1919, *19549*, *19550*, Oct. 16, 1920; northwest of Wynoose, Richland Co., *Robt. Ridgway 777*, Aug. 27 and Sept. 7, 1919; Little Wabash River, s. e. corner Clay Co., *Robt. Ridgway 1557*, Oct. 12, 1921. MISSOURI: Campbell, (Dunklin Co.), *B. F. Bush 6365* (TYPE), Oct. 6, 1910.

× **Quercus inconstans** Palmer (*Q. Emoryi* × *hypoleucoides*), Jour. Arnold Arb. 10: 34. 1929.

× *Quercus livermorensis* Muller, Amer. Midl. Naturalist 19: 585. 1938.

Two shrubby plants believed to be this hybrid were found near the head of a rocky ravine east of Livermore peak, in the Davis Mountains, at an altitude of about 2000 meters. Both supposed parent species were growing near by. The intermediate characters of the leaves indicate the hybrid origin of the plant, as well as the association and its rarity. The leaves are oblong-elliptic to oblanceolate in outline, mostly 4–8 cm. long and 2–4 cm. wide, with 2–3 or rarely 4 pairs of pungent, bristle-tipped teeth, coriaceous or subcoriaceous, with slightly revolute margins, green and thinly stellate-pubescent above, coated beneath with thick, pale, rather easily detached tomentum: veins slightly impressed above, prominent

beneath; petioles 6–10 mm. long. The pistillate flowers are borne on short hairy peduncles or are nearly sessile. No acorns were found. The leaves resemble those of *Quercus Emoryi* in the toothed margins, but they are mostly cuneate or narrowed and rounded at the base, as in *Q. hypoleucoides*. They also resemble the latter in the pale felty tomentose under surface. The fact that the tomentum is loosely attached and can be rubbed off with the finger is particularly significant, as this is often the case in hybrids between a glabrous and a strongly pubescent species.

TEXAS: Davis Mountains, Jeff Davis Co., *E. J. Palmer 30934* and *30935* (TYPE), June 15, 1926; Davis Mountains, near Mt. Livermore, *L. C. Hinckley*, May 1, 1937 (G).

× **Quercus Jackiana** Schneider (*Q. alba* × *bicolor*), Ill. Handb. Laubh. 1: 202. 1904. — Trelease, Mem. Nat. Acad. Sci. 20: 15. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922.

The type tree of this hybrid was discovered by Professor J. G. Jack in Franklin Park, Boston, Mass., growing in native woods. It has since been found at several other stations in this and other states. The leaves are more or less intermediate in outline between those of the parent species, but generally have more resemblance to those of the white oak, with deep nearly simple lobes or with the middle or upper pairs sometimes slightly broadened and indented at the apex, and with the under surface of the blades covered with a more or less dense tomentum, similar to that of *Quercus bicolor*. The fruit is sometimes nearly sessile, resembling large-fruited forms of the white oak except for the deeper cups, or it may be peduncled as in the swamp white oak.

MASSACHUSETTS: Franklin Park, Boston, *J. G. Jack*, Sept. 12, 1895, Sept. 14, 1902, Sept. 18, 1904, Sept. 20, 1916, Jan. 21, 1926, *C. E. Faxon*, Sept. 20, 1916; East Walpole, *J. G. Jack 3924*, Sept. 25, 1929; between Jamaica Plain and Dedham, *H. J. Koehler*, Aug. 18, 1925. RHODE ISLAND: near Diamond Hill, Providence Co., *E. J. Palmer 46915*, Sept. 11, 1943. NEW YORK: Black Rock Forest, Cornwall on Hudson, *H. H. Tryon 1, 2*, 1903. INDIANA: northeast of Onward, Cass Co., *C. C. Deam 51066*, Sept. 18, 1931. ILLINOIS: Coulterville, Randolph Co., *E. J. Palmer 17090*, Oct. 24, 1919. This hybrid is also in cultivation in the Arnold Arboretum.

× **Quercus jolonensis** Sargent (*Q. Douglasii* × *lobata*), Bot. Gaz. 65: 456. 1918; Man. Trees N. Amer. ed. 2, 248, 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 15. 1924.

With leaves smaller and usually less deeply divided than in *Quercus lobata*.

CALIFORNIA: between King City and Jolon, *A. Eastwood 44*, Sept. 17, *155*, *156*, *163*, Sept. 18, 1894, *164* TYPE, *165*, Sept. 22, 1894.

× **Quercus Joorii** Trelease (*Q. falcata* × *Shumardii*), Mem. Nat. Acad. Sci. 20: 15. 1924.

I have not seen the type specimen nor any material that can be referred to this hybrid. *Quercus Shumardii* was questioned as one of the parents in the original publication, but the characters given in the brief description seem to indicate that it was correctly placed. The parent species grow together over a wide range, and it is to be expected that hybrids would appear. The type specimen was collected by Joor at Galveston, Texas, Sept. 25, 1884, according to Trelease.

× **Quercus Leana** Nuttall (*Q. imbricaria* × *velutina*), Sylva N. Amer. 1: 13, pl. 5 bis. 1819. — Sargent, Silva 8: 176, pl. 434. 1895; Man. Trees N. Amer. ed. 2, 268. 1922. — Trelease, Proc. Amer. Phil. Soc. 56: 50. 1917; Mem. Nat. Acad. Sci. 20: 15. 1924.

The history and characters of this widely distributed hybrid were discussed in the introduction. In many cases it appears to come true to type in seedlings.

PENNSYLVANIA: Hyndman, Bedford Co., *J. K. Small*, Aug. 19–23, 1890. MARYLAND: Burnt Mills, *H. W. Henshaw*, Aug. 31, 1887 and May 6, 1888. DISTRICT OF COLUMBIA: Carroll Estate, *H. W. Henshaw*, June 21, 1886; Washington, *Lester F. Ward*, Sept., 1888, *George Vasey*, 1876. NORTH CAROLINA: near Biltmore, ex Herb. Biltmore, no. *821*, April 25, Aug. 6 and Oct., 1896, no. *421-b*, April 30, Sept. 11 and Oct. 11, 1897; Franklin, *C. S. Sargent*, Sept. 25, 1885, *F. E. Boynton*, 1893; Charleston, Swaine Co., *C. S. Sargent*, 1885. MICHIGAN: northwest of Ann Arbor, *J. H. Eihlers 3597*, Oct. 16, 1927. OHIO: Cedar Point, Erie Co., *W. A. Kellerman*, July 19, 1899; Youngstown, Mahoning Co., *R. E. Horsey 669*, Sept. 28, 1917, Oct. 2, 1918. INDIANA: south of Bedford, Lawrence Co., *Ralph M. Kriebel 1443*, Oct. 18, 1933; near Bedford, *C. C. Deam 10240*, Oct. 14, 1911; Crown Point, Lake Co., *C. C. Deam 18088*, Aug. 23, 1911; southwest of Mt. Vernon, Posey Co., *C. C. Deam 56919*, Oct. 7, 1935; northwest of Mt. Summit, Henry Co., *J. L. Kirling 4069*, Sept. 18, 1936. ILLINOIS: Willow Springs, *E. J. Hill*, July 16, 1890, Oct. 16, 1891, May 23, 1892; near Olney, Richland Co., *Robt. Ridgway 1321*, Oct. 8, 1920; Marion Township, Richland Co., *Robt. Ridgway 3068*, July 22, 1928; Simpson, Johnson Co., *E. J. Palmer 16670*, Oct. 3, 1919, *19580*, Oct. 23, 1920; Peters Creek, Hardin Co., *E. J. Palmer 15467*, June 10, 1919, *17035*, Oct. 12, 1919, *19590*, Oct. 27, 1920. KENTUCKY: Bowling Green, *S. F. Price*, 1902. MISSOURI: Independence, Jackson Co., *B. F. Bush 94*, Nov. 6, 1894; Swope Park (Kansas City), *B. F. Bush 10243*, Nov. 6, 1923, *E. J. Palmer 24377*, Nov. 5, 1923; Greenwood (Jackson Co.), *B. F. Bush 10331*, *10331-a*, Sept. 5, 1924, *E. J. Palmer 26033*, Sept. 5, 1924; Washington Co., *G. W. Letterman*, Aug., 1877; Hog Hollow, Jefferson Co., *J. H. Kellogg 25980*, June 14, 1932; Hannibal, Marion Co., *E. J. Palmer 20393*, Sept. 7, 1921; Arcadia, Iron Co., *E. J. Palmer 30232*, May 21, 1926; Mine La Motte, Madison Co., *E. J. Palmer 31574*, Sept. 6, 1926; Greenfield, Dade Co., *E. J. Palmer 10573*, Aug. 5, 1916; between Fairport and Maysville, DeKalb Co., *Palmer & Steyermark 41389*. Cultivated in the Arnold Arboretum and in other botanical gardens and parks in America and Europe.

× **Quercus ludoviciana** Sargent (*Q. falcata* × *Phellos*), Trees and Shrubs 2: 222. 1913; Man. Trees N. Amer. ed. 2, 264. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 16. 1924.

× *Quercus falcata* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 94. 1898. Not Michaux. 1801.

× *Quercus subfalcata* Trelease, Proc. Amer. Phil. Soc. 56: 52. 1917.

× *Quercus ludoviciana* var. *subfalcata* Rehder, Jour. Arnold Arb. 7: 240. 1926.

The parentage of this hybrid was given in the original description as *Quercus pagodaefolia* × *Phellos*. But in later publications *Quercus pagodaefolia* was held by Sargent to be a variety of *Q. falcata*. If this disposition is correct, as in my opinion it is, only one inter-specific hybrid can be recognized. Rehder proposed, as cited above, to restrict the name to the cross between *Q. falcata* var. *pagodaefolia* and *Q. Phellos*. But an examination of a series of specimens does not show any satisfactory way of determining which variety of the southern red oak was involved in the type specimens or in other collections.

GEORGIA: Traders Hill, Charlton Co., *J. K. Small*, June 12–15, 1895. KENTUCKY: Wickliffe, Ballard Co., *E. J. Palmer 16507*, Sept. 20, 1919. MISSOURI: Campbell,

(Dunklin Co.), *B. F. Bush 610-b*, July 28, 1895. ARKANSAS: near Little Rock, *Geo. M. Merrill 1413*, Nov. 2, 1938; Piggott, Clay Co., *Delzie Demaree 4154*, April 11, 1927; Brinkley, Monroe Co., *Delzie Demaree 10873*, Aug. 30, 1934; banks of Little Missouri River, Pike Co., *Delzie Demaree 9397*, Sept. 29, 1932; near Conway, Faulkner Co., *Delzie Demaree 10093*, 10097, Nov. 4, 1932; McNab, Hempstead Co., *E. J. Palmer 22466*, April 25, 1923, *24013*, Oct. 4, 1923, *29437*, Oct. 28, 1925; Fulton, *B. F. Bush 5693*, March 23, *5833*, June 11, 1909. MISSISSIPPI: Bay St. Louis, *R. S. Cocks*, Sept. 1923. LOUISIANA: Peterville, w. of Opeleusas, *C. S. Sargent*, April 4, Oct. 10, 1913 (TYPE); Lafayette, *Clair A. Brown 9795*, Aug. 30, 1943. ALABAMA: near Sardis, *R. S. Cocks 814*, July 30, *938*, Sept. 17, 1915. TEXAS: Houston, *E. J. Palmer 12754*, Sept. 15, *12769*, Sept. 16, *12774*, Sept. 17, 1917. This hybrid has not proved hardy at the Arnold Arboretum.

(?) × **Quercus ludoviciana** var. **microcarpa** (Dippel) Rehder, Jour. Arnold Arb. 7: 239. 1926.

Quercus Phellos microcarpa Dippel, Handb. Laubh. 108, fig. 49, 1892.

× *Quercus subfalcata* var. *microcarpa* Sargent, Bot. Gaz. 65: 454. 1918.

Sargent's description of this ambiguous hybrid and the notes on it by Rehder under the name accepted here were based on trees cultivated in the Arnold Arboretum and obtained from the nurseries of Wezelburg and Sons, Hazerswaoude, Holland, in 1903, under the name of *Quercus chinensis microcarpa*. It appears to have been in cultivation in European gardens for many years under this name or as *Q. microcarpa*, *Q. robur microcarpa*, or *Q. Phellos microcarpa*. The origin of the plant is unknown and its relationship seems to be very doubtful. *Quercus Phellos* appears to be one of the parents, but there is little to suggest any known form of *Q. falcata*. The leaves are mostly linear-lanceolate or oblong-lanceolate in outline, of approximately the size and relative length and breadth of those of the willow-oak, but nearly all of them are toothed or lobed on the margins with sharp or obscure bristle-tipped projections. On some blades the lobes or teeth are symmetric and paired and on others they are very irregular. The young branchlets and the under surface of the young leaves are covered with a pale, easily detachable pubescence, but they become quite glabrous late in the season. The acorns are similar in shape to those of the willow-oak, but are smaller than the average for that tree. It is possible that the plant may have arisen as a cross between *Quercus incana* and *Q. Phellos*. But as the leaves in typical forms of both of these species are entire, it would not be expected that a hybrid between them would have toothed or lobed leaves. It may also be noted that *Quercus incana* has not been successfully grown at the Arnold Arboretum, but the hybrid appears to be perfectly hardy, as is also the willow-oak. While it seems to me to be quite unlikely that this supposed hybrid originated from a cross in which any form of *Quercus falcata* was involved, it is perhaps best in the absence of any positive evidence to leave it under its present name. The trees in the Arboretum often produce good crops of acorns, and it is possible that if a series of seedlings was grown from them, some significant results might be obtained.

× **Quercus macnabiana** Sudworth (*Q. Durandii* × *stellata*), Check List Forest Trees U. S. 103. 1927.

Quercus Durandii × *stellata* Palmer, Jour. Arnold Arb. 4: 21. 1923.

Quercus Mahloni Palmer (as *Q. breviloba* × *stellata*), Jour. Arnold Arb. 18: 139. (correction p. 361). 1937.

Two trees of × *Q. macnabiana* were found growing with the supposed parent species; and a series of specimens with young and mature leaves, flowers, and fruit clearly indicates the parentage. The name × *Quercus Mahloni* was proposed for a hybrid between the shrubby variety of *Q. Durandii* and *Q. stellata*, collected in the Arbuckle Mountains, Oklahoma, by George Mahlon Merrill. The typical variety of *Quercus Durandii* is not found in the region, and there can be no doubt that one of the parents was *Q. Durandii* var. *breviloba* (Sarg.) Palmer. But there are no clear characters except the shrubby habit and smaller size of the leaves to distinguish it from × *Quercus macnabiana*, and it may consistently be placed under the earlier name.

ARKANSAS: McNab, Hempstead Co., *E. J. Palmer 8965*, Oct. 10, 1915, *12659*, *12662*, Sept. 6, 1917, *20645*, Sept. 26, 1921, *20715*, April 6, 1922, *29442*, Oct. 28, 1925. OKLAHOMA: Platt National Park, Murray Co., *G. M. Merrill 1634*, Oct. 28, 1935. TEXAS: Strawn, Paolo Pinto Co., *E. J. Palmer 14267*, June 27, 1918; Brownwood, Brown Co., *E. J. Palmer 29501*, Nov. 1, 1925.

× **Quercus Mellichampi** Trelease (*Q. laevis* × *laurifolia*), Proc. Amer. Phil. Soc. 56: 50. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924. — Sargent, Bot. Gaz. 65: 451. 1918; Man. Trees N. Amer. ed 2, 254. 1922.

Quercus Catesbaei × *laurifolia* Engelmann, Trans. Acad. Sci. St. Louis 3: 539. 1877.

The leaves in this hybrid are extremely variable and often eccentrically lobed.

SOUTH CAROLINA: Bluffton, *J. H. Mellichamp*, April 13 and Nov. 19, 1895, *C. S. Sargent*, Oct. 4, 1894; Port Royal, *T. G. Harbison 15*, Dec. 8, 1917. FLORIDA: Jacksonville, *T. G. Harbison 28*, Dec. 3, 1917, *A. D. Jackson*, Dec., 1923; Eustis, *T. G. Harbison 12*, June 22, 1919; San Mateo, *T. G. Harbison 35*, Dec. 6, 1917; near Gainesville, *W. A. Murrill*, Jan. 22, 1940; Orlando, *C. H. Baker 2*, April 5, 1915; Plymouth, *T. G. Harbison 23*, *24*, Nov. 26, 1916; Zellwood, *T. G. Harbison 25*, *26*, *27*, *28*, *29*, Nov. 26, 1916; *2*, Dec. 4, 1917.

× **Quercus Morehus** Kellogg (*Q. Kelloggii* × *Wislezeni*), Proc. Calif. Acad. Sci. 2: 36. 1863. — Greene, W. Amer. Oaks 3, 47, 49, pl. 2. 1889. — Sargent, Silva 8: 120, pl. 407. 1895; Man. Trees. N. Amer. ed. 2, 271. 1922.

× *Quercus moreha* Trelease, Proc. Amer. Phil. Soc. 56: 50. 1917.

CALIFORNIA: Newcastle (Placer Co.), *T. S. Brandegee*, Sept., 1886, July 5 and 21, 1889, *Alice Eastwood*, Sept. 9, 1894, *142*, Sept. 12, 1894; Auburn, *Engelmann & Sargent*, Oct. 10, 1880, *Mary E. P. Ames*, Feb. 1894; San Bruno Hills, San Mateo Co., *G. Ward*, April 12, 1941; Mt. Tamalpas (Marin Co.) *A. Eastwood 139*, *140*, Sept. 15, 1894, *Rimo Bacigalupi*, Nov. 12, 1922; Saudalito (Marin Co.), *A. Eastwood 141*, Sept. 15, 1894, *278*, *June 9*, 1912, April, 1920, April 1, 1921, *Lewis S. Rose 33072*, April 12, 1933; Clinton, Amador Co., *Geo. Hansen 916*, April 29, 1892, Sept. 15, 1895; Middle Fork, Amador Co., *Geo. Hansen 1197*, April 27, 1892, *1231*, Aug. 17, 1895; Pine Grove, Amador Co., *Geo. Hansen 914*, April 2, 1894, Irishtown, Amador Co., *Geo. Hansen 915*, Aug. 12, 1895; Hetch Hetchy Valley, Toulumne Co., *C. M. Belshaw 25*, Aug. 2, 1935; between Auburn and Folsom, Sacramento Co., *C. B. Wolf & B. D. Stark 5485*, Sept. 24, 1933, *C. B. Wolf 8341*, March 30, 1937; west of Laytonville, Mendocino Co., *Joseph P. Tracy 15198*, Oct. 11, 1936; Ukiah, Mendocino Co., *Alice Eastwood 3279*, June 13, 1913; between Oathill and Mt. Sanhedrin, Lake Co., *Alice Eastwood 12951*, May 25, 1925; 12 miles north of Sacramento, *Wm. Vortriede*, Oct., 1927; Doane Valley, Palomar Mt., San Diego Co., *C. H. Muller 4026*, Aug. 9, 1941; summit of Palomar Mt., *C. H. Muller 4031*, Aug. 9, 1941.

× **Quercus moultonensis** Ashe (*Q. Phellos* × *Shumardii*), Rhodora 24: 78. 1922.

The two species given as parents of this hybrid are often found growing together throughout their common range in the coastal plain and the lower Mississippi Valley. Ashe's description was based upon specimens from the Moulton Valley, of the Tennessee River in Lawrence Co., Tennessee. I have not seen the type material, but several specimens in the herbarium of the Arnold Arboretum appear to belong here.

VIRGINIA: Suffolk, *Alfred Rehder*, Aug. 21, 1908. ARKANSAS: Bayou Bartholomew, Jefferson Co., *Delzie Demaree 13939*, Oct. 11, 1936; Newport, Jackson Co., *Delzie Demaree 20385*, Aug. 26, 1939; Rowland, Pulaski Co., *Delzie Demaree 8833*, Oct. 30, 1931; Conway, Faulkner Co., *Delzie Demaree 10086*, Nov. 4, 1932.

× **Quercus mutabilis** Palmer & Steyermark (*Q. palustris* × *Shumardii*), Ann. Mo. Bot. Gard. 22: 521. 1935.

The description was based upon specimens from a single tree found growing with *Quercus palustris* and *Q. Shumardii* var. *Schneckii* in western Missouri, and the latter was given as one of the parents. However, as in other cases, it does not seem practicable to distinguish which particular variety of a species is involved in a hybrid. So the name should be considered applicable to hybrids between any varieties of the parent species. The leaves and the fruit resemble more closely those of *Quercus Shumardii* than of the other parent, but the bark and habit of the tree and the thin-shallow cups of the acorns indicate hybridization with *Q. palustris*. The leaves of some of the other specimens cited below have more resemblance to those of *Quercus palustris*.

MISSOURI: Monteith Junction, Bates Co., *E. J. Palmer 26069* (TYPE), Sept. 10, 1924; Butler Co., *B. F. Bush 3770*, Oct. 19, 1905; Williamsville, Wayne Co., *E. J. Palmer 19423*, Oct. 9, 1920; Cole Camp, Benton Co., *E. J. Palmer 26358*, Oct. 1, 1924.

× **Quercus neopalmeri**[1] Sudworth (*Q. nigra* × *Shumardii*), Check List Forest Trees U. S. 92. 1927.

Quercus nigra × *Shumardii* Palmer, Jour. Arnold Arb. 4: 21. 1923.

The original specimen was without fruit, and several other sterile specimens have since been found in other places.

GEORGIA: Wilkes Co., *T. G. Harbison 15*, June 15, 1919; Folkston, *T. G. Harbison 101*, Nov. 26, 1919. FLORIDA: Oviedo, *T. G. Harbison 11*, May 28, 1917; Sumner, *T. G. Harbison 30*, June 16, 1917. ARKANSAS: McNab, Hempstead Co., *E. J. Palmer 22301* (TYPE), Oct. 12, 1922. ALABAMA: Cullman, *T. G. Harbison 12*, Nov. 4, 1919.

× **Quercus Nessiana** hybr. nov. (*Q. bicolor* × *virginana*).

Arbor foliis tarde deciduis obovatis 5–13-lobatis vel raro incomposite pauci-lobatis vel integris maturis subcoriaciis supra fere glabratis infra dense tenuiter pubescentibus.

The hybrid between the swamp white oak and the live oak has not so far been found in the wild state. But the two species were crossed by the late Professor Helge Ness at the Experiment Station of the Texas Agricultural College, College Station, Texas.

[1] Arbor foliis ferme obovatis incomposite lobatis basi cuneatis maturis glabris venulorum axillis barbatis exceptis.

Writing about some of the hybrids in cultivation, Ness stated: "From artificial pollination made April 3, 1918, we have three specimens of *Q. platanoides* (male) and *Q. virginiana* (female) in the Arboretum of the Experiment Station. They were planted in 1920. One of them produced a few acorns in 1923. This year, 1926, all bore heavy crops of acorns, although no male flowers were produced. They are very uniform in character, strongly resembling *Q. platanoides;* the only difference being that the leaves are somewhat smaller, more persistent, firmer, and the crown more densely branched than in *Q. platanoides*."

A specimen sent to the Arnold Arboretum about 1923 consists of two young branches with well developed leaves, resembling those of *Quercus bicolor* in shape and with the other characters mentioned by Ness. Recently Dr. W. S. Flory, Jr. has sent us a series of specimens and photographs showing leaves and fruit. The prevailing type of leaves on the specimens numbered 1 and 3 by Flory is much the same as on the Ness specimen. On no. 2 the leaves are much more variable, relatively narrower, some of them being irregularly lobed or toothed, and a few have blades with entire margins. The lobes and teeth are mucronate tipped, and the under surface of the blades is covered with a dense fine pale stellate pubescence similar to that of *Quercus bicolor*. The peduncled acorns resemble those of *Quercus bicolor* but are smaller and with deeper, more turbinate cups.

× **Quercus organensis** Trelease (*Q. arizonica* × *grisea*), Proc. Amer. Phil. Soc. 56: 50. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924.

Quercus arizonica × *grisea* Wooton & Standley, Contrib. U. S. Nat. Herb. 19: 171. 1915.

A single tree growing with the supposed parent species and believed to be a hybrid between them was found at Van Patten's Camp in the Organ Mountains, according to Wooton and Standley. I have not seen the material.

(?) × **Quercus oviedoensis** Sargent (*Q. incana* × *myrtifolia*), Bot. Gaz. 65: 459. 1918; Man. Trees N. Amer. ed. 2, 266. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 16. 1924.

The type specimen of this came from a large shrub found near Oviedo, Seminole Co., Fla., and said to be growing with the supposed parent species. Another specimen from the same locality was described as coming from a small tree. All of the material is sterile and its identity seems rather doubtful.

FLORIDA: Oviedo, *T. G. Harbison 19, 20* (TYPE), May 29, 1917.

× **Quercus paleolithicola** Trelease (*Q. ellipsoidalis* × *velutina*), Proc. Amer. Phil. Soc. 56: 50, pl. 1. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924.

Forms of the black oak and of the jack oak approach each other in leaf and fruit characters and hybrids between them are somewhat obscure. The two species often grow in proximity and there is little doubt that they sometimes hybridize. The hybrids can generally be recognized by intermediate characters in the leaves and fruit. The young leaves, branchlets

and winter-buds are more pubescent than in *Quercus ellipsoidalis*, and the cups of the acorns are usually turbinate but with rather loose, pubescent scales.

WISCONSIN: Lake Geneva, *C. S. Sargent*, April 19, 1916; Sugar Loaf, Columbia Co., *Huron H. Smith 8067*, Aug. 5, 1922. INDIANA: southwest of Vistula, Elkhart Co., *C. C. Deam 61589*, Oct. 2, 1941, *Ralph M. Kriebel 10048*, Oct. 4, 1942; northwest of Shipshewana, Lagrange Co., *Ralph M. Kriebel 10044*, Oct. 4, 1942. IOWA: Fayette Co., *Bruce Fink*, 1893; Eldora, *L. H. Pammel*, Aug. 19, 1930.

× **Quercus pastorensis** C. H. Muller (*Q. clivicola* × *glaucophylla*), Jour. Arnold Arb. 17: 164. 1936.

MEXICO: Puerto de Pastores, southeast of Galena, Sierra Madre Oriental, *C. H. & M. T. Muller*, *1000*, *1005*, July 5, 1934, *1296* (TYPE), *1297*, Aug. 2, 1934.

× **Quercus podophylla** Trelease (*Q. incana* × *velutina*), Proc. Amer. Phil. Soc. 56: 51. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 243. 1922.

× *Quercus petiolaris* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 90. 1894. Not. *Q. petiolaris* Bentham, 1840.

Ashe gave the parentage of × *Quercus petiolaris* as *Q. cinerea* × *Q. tinctoria?* But his rather detailed description seems to substantiate the suggested parentage. It was stated that five or six trees were seen, the bark of all of them having the general aspect of *cinerea* (*incana*). The locality was not given, but, presumably, they were found in North Carolina. I have not seen any material of this hybrid.

(?) × QUERCUS PSEUDOMARGARETTA Trelease, Mem. Nat. Acad. Sci. 20: 16. 1924.

The parentage given by Trelease was *Quercus Margaretta* × *stellata*. The former was regarded by him as a distinct species and not as a variety of *Q. stellata* as held by Sargent and as here considered. Whatever view is taken of this, the two suggested parents approach each other so closely in leaf and fruit characters — especially in forms found in the western part of the coastal plain — that a hybrid between them would be very obscure and difficult to detect. I have not seen the type specimen (*Fisher 5116*, Houston, Tex.), but Trelease stated that it closely resembled *Margaretta*, and from his brief description and from what I have seen of the post-oak in the part of the country from which it came, I think it is probably identical with *Quercus stellata* var. *araniosa* Sargent.

× **Quercus Rehderi** Trelease (*Q. ilicifolia* × *velutina*), Proc. Amer. Phil. Soc. 56: 51. 1917; Trans. Nat. Acad. Sci. 20: 16. 1924. — Sargent, Man. Trees. N. Amer. ed. 2, 255. 1922.

Quercus ilicifolia × *velutina* Rehder, Rhodora 3: 133, pl. 24, fig. 1–2. 1903.

This hybrid seems to be comparatively frequent where the bear-oak and the black oak grow together. The leaves of the two species are quite different from each other in character and in the hybrids they are obviously intermediate. Most of the specimens observed in the field are shrubby, although sometimes stouter and more tree-like than is usual in *Quercus ilicifolia*.

MASSACHUSETTS: Blue Hills, near Boston, *A. Rehder*, Sept. 18 & 22, 1900, March 13, 1901; South Blue Hill Ave., near Boston, *E. J. Palmer 20190*, *20192*, June 17, 1921; near Boston, *Rufus N. Carr*, Oct. 19, 1927; Norwood, *J. G. Jack*, June 25,

1904; Lynn Woods, *A. Rehder*, Oct. 3, 1903; West Peabody, *J. Robinson*, Sept. 12, 1880; Marthas Vinyard, *Sidney Harris*, May 30, 1901; Chilmark, Marthas Vinyard, *Sidney Harris*, May 30, June 12, 1902, Aug. 31, 1903. RHODE ISLAND: Slatersville, Providence Co., *E. J. Palmer 43296*, July 17, 1927. PENNSYLVANIA: Reading, Berks Co., *E. J. Palmer 36306*, Sept. 11, 1929; near White Bear, Berks Co., *David Berkheimer 4379*, Sept. 26, 1943.

(?) × QUERCUS RICHTERI Baenitz, Allg. Bot. Zeitschr. 9: 85. 1903.

This name was proposed for a supposed hybrid between *Quercus borealis* (*rubra*) and *Q. palustris* and was based on a tree growing in Scheitniger Park, Breslau, Silesia. Specimens from the type tree collected and distributed by Baenitz and others are in the herbarium of the Arnold Arboretum. Croizat (18) after studying the material concluded that there was nothing to distinguish it from *Quercus coccinea* Muenchh. And on the evidence, I am inclined to agree with him that × *Quercus Richteri* should be considered a synonym of that species. Several specimens from native trees in different parts of the United States are also in the Arboretum herbarium that suggest hybrids between the red oak and the pin-oak, but since all of them seem to be slightly questionable and since the name proposed by Baenitz is invalid, it is perhaps best to leave them unnamed for the present.

× **Quercus Robbinsii** Trelease (*Q. coccinea* × *ilicifolia*), Proc. Amer. Phil. Soc. 56: 51. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 248. 1922.

Quercus coccinea × *ilicifolia* Gray, Man. Bot., ed. 5, 454. 1867. — Robbins ex Engelmann (as *ilicifolia* × *coccinea*), Trans. Acad. Sci. St. Louis 3: 542. 1877.

Specimens of this hybrid may be difficult to distinguish from × *Quercus Rehderi*. The leaves and branchlets are less pubescent and the cups of the acorns are deeper.

MASSACHUSETTS: Uxbridge, *J. W. Robbins* (without date), (G); North Easton, *J. S. Ames 1912*, Sept. 17, 1917; Framingham, *A. J. Eames*, Sept. 6, 1909 (G). PENNSYLVANIA: Wilkes Barre, Luzerne Co., *E. J. Palmer 36289*, Sept. 9, 1929.

× **Quercus Rudkini** Britton (*Q. marilandica* × *Phellos*), Bull. Torrey Bot. Club 9: 13, pl. 10–12, fig. 3–5. 1888. — Sargent, Silva 8: 181, pl. 437. 1895; Man. Trees N. Amer. ed. 2, 259. 1922. — Trelease. Mem. Nat. Acad. Sci. 22: 16. 1924.

× *Quercus dubia* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 93. 1894.

Trees that appear to be hybrids between the black jack oak and the willow-oak have been found widely scattered through the common range of the two species. The foliage is extremely variable and ranges between the leaf types of the two species and with some eccentric forms. In describing × *Quercus dubia*, Ashe expressed the opinion that it was a hybrid between *Quercus coccinea* and *Q. Phellos*, although he was in doubt about it. Sargent (53) considered it a synonym of × *Q. atlantica* Ashe, which he held to be a cross between *Q. incana* and *Q. laurifolia*. An isotype in the herbarium of the Arnold Arboretum shows it to be an anomalous form with large entire, oblong-elliptic leaves, and it appears to me to be an extreme form of × *Quercus Rudkini*.

NEW YORK: Tottenville, Staten Island, *Arthur Hollick 4, 5, 15*, Sept. 2, 1888. NEW JERSEY: Keyport, *W. T. Davis 146*, Nov. 13, 1910; Bennett, Cape May Co.,

Bayard Long 7947, Oct. 29, 1912. DELAWARE: Stanton, *J. P. Otis*, 1920. VIRGINIA: South Arlington, *E. S. Steele*, Aug. 8, 1899. NORTH CAROLINA: Falls of Yadkin River, Stanley Co., *J. K. Small*, Aug. 18, 1893; Blondin Co., *W. W. Ashe 247*, June and Nov., 1895; Raleigh, *W. W. Ashe*, March and Oct.; Chapel Hill, *T. G. Harbison 25*, May 30, 1919; Abbottsburg, Bladen Co., *T. G. Harbison 11*, 1916, Oct. 5, 1917, *J. S. Holmes*, May 9, 1918. SOUTH CAROLINA: Charleston, *T. G. Harbison 30*, May 1, 1917. GEORGIA: Wilkes Co., *T. G. Harbison 48*, June 15, 1919. FLORIDA: Gainesville, *T. G. Harbison 46*, June 17, 1917. ARKANSAS: Fulton, Hempstead Co., *B. F. Bush 1093*, Oct. 17, 1901, *5946*, Oct. 5, 1909, *E. J. Palmer 10504*, July 17, 1916, *10580*, Sept. 4, 1916, *22276*, Oct. 12, 1922, *22465*, April 25, *23999*, Oct. 4, 1923. LOUISIANA: west of Bogalusa, Washington Parish, *Clair A. Brown 7721*, June 4, 1939; Chestnut, Natchitoches Parish, *E. J. Palmer 9471*, April 17, 1916. Cultivated at Arnold Arboretum, Brooklyn Botanic Garden, and University of North Carolina.

× **Quercus runcinata** (A. DC.) Engelmann (*Q. borealis* × *imbricaria*), Oaks of U. S. 20. 1876 — Sargent, Man. Trees N. Amer. ed. 2, 243. 1922.

Quercus rubra β runcinata A. de Candolle, Prodr. 16(2): 60. 1864. — Gray, Man. Bot. ed. 5, 454. 1868.

Engelmann stated that he collected the type material of this in the bottomlands of the Mississippi River opposite St. Louis, growing with *rubra*, *imbricaria*, and *palustris*. He believed it to be a hybrid between the first two, and sent a specimen under the name × *Quercus runcinata* to A. de Candolle, who regarded it as merely a form of the red oak and so published a description under the combination shown above. Engelmann in his notes (24) in which he published the name × *Quercus runcinata* for the first time expressed himself as willing to defer to Candolle's opinion. However, there can be little doubt that Engelmann's plant and numerous later discoveries are really hybrids of the parentage he first suggested.

PENNSYLVANIA: Westmoreland Co., *Henry Chisman*, 1936; near Ambler, *James R. Gilpin*, Sept. 19, 1934. MARYLAND: Ammendale, *F. S. C.* —, Oct. 13, 1928. OHIO: near Akron, *Fred H. Gleny*, 1938; West Union, *Conrad Roth*, Oct., 1931; Columbus, *W. A. Kellerman* (without date). INDIANA: near Bedford, *Ralph M. Kriebel 2767*, *2768*, Oct. 1934; near Oakland City, Gibson Co., *Ralph M. Kriebel*, 1939. ILLINOIS: near Sannon Bridge, Wayne Co., *Robt. Ridgway 91*, Oct. 21, 1914; near mouth of Turkey Creek, Richland Co., *Robt. Ridgway 26*, Aug. 12, 1917; 10 miles northeast of Olney, Richland Co., *Robt. Ridgway 2687*, Sept. 19, 1926; East St. Louis, *Geo. Engelmann*, Sept. 28, 1849; Tunnel Hill, Johnson Co., *E. J. Palmer 19579*, Oct. 23, 1920; Simpson, Johnson Co., *E. J. Palmer 16666*, Oct. 4, 1919. KENTUCKY: Sparta, *Donaldson*, 1935. MISSOURI: Allenton, St. Louis Co., *G. W. Letterman 2*, 1880, *3*, July, 1878, *5*, May 10, 1891, *6*, Nov. 1, 1891, *36* (without date), Oct. 1890; near Independence, *B. F. Bush 623*, Sept. 16, 1894, *628*, Oct. 14, 1895, *10347-a*, Sept. 22, 1924; Hyde Park, Kansas City, *Kendall Laughlin*, Oct., 1935; Van Buren, Carter Co., *E. J. Palmer 19497*, Oct. 11, 1920. Cultivated in the Arnold Arboretum, Bronx Park, New York, and in other parks and gardens in the United States and Europe.

× **Quercus Sargentii** Rehder (*Q. montana* × *robur*), in Bailey Stand. Cyclop. Hort. 5: 2886. 1916; Mitt. Deutch. Dendr. Ges. 1915(24): 215. 1916. — Sargent, Man. Trees N. Amer. ed. 2, 306. 1922.

This hybrid between the chestnut-oak and the English oak was discovered on the grounds of Professor C. S. Sargent, Holm Lea, Brookline, Mass. Large trees are now growing in the Arnold Arboretum grown from seeds

of the original tree planted in 1877. The seedlings, although differing from each other, retain the intermediate characters of the original hybrid.

× **Quercus Saulei** Schneider (*Q. alba* × *montana*), Ill. Handb. Laubh. 1: 203. 1904. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922.

Quercus alba × *Prinus* Engelmann, Trans. Acad. Sci. St. Louis 3: 399. 1877. — Vasey, Bull. Torrey Bot. Club 10: 25, pl. 28–30. 1883. — Sargent, Silva 8: 18, pl. 361. 1895.

This seems to be one of the commonest hybrids among the white oaks, and it may be looked for wherever the two parent species are found growing together. The leaves are usually symmetric and are more uniform in type than is the case with most hybrids. The blades usually resemble those of the chestnut-oak in outline, but are more deeply incised with mostly simple ovate or oblong lobes rounded at the apex.

VERMONT: Monkton, *C. G. Pringle*, May 21, Sept. 29, 1879. MASSACHUSETTS: Jamaica Plain, *C. E. Faxon*, July 16, 1897, *J. G. Jack*, March 25, Sept. 21, 1914; Concord, *H. A. Purdie*, Aug. 1903; Middlesex Fells, *H. J. Koehler*, June, 1908. RHODE ISLAND: Providence, *J. F. Collins*, Oct. 2, 1892; Durfee Hill, near Chepachet, Providence Co., *E. J. Palmer 44641*, Aug. 20, 1938; near Diamond Hill, Providence Co., *E. J. Palmer 46132*, June 14, 1942, *47913*, Aug. 11, 1946. NEW YORK: Fort Wadsworth, Staten Island, *Leon Croizat*, June 15, 1937; Alley Pond Park, New York, *Leon Croizat*, Sept. 15, 1936. PENNSYLVANIA: Roslyn, *C. S. Sargent*, Sept. 13, 1914, *J. C. Swartley S-856*, Sept. 1936; Rocky Mountain Run, Franklin Co., *John C. Kase 17*, 1935; near Hatboro, *Charles C. Mann;* Bedford Co., *David Berkheimer 5417*, Aug. 16, 1944. NEW JERSEY: Elwood, *Isaac C. Martindale*, Aug., 1877; near Newark, *Hans J. Koehler*, July, 1906; Sandsboro, *C. S. Sargent*, Aug. 22, 1916; Ocean Grove, *J. K. Hayward*, 1890. DISTRICT OF COLUMBIA: Washington, *John Saul*, May (and autumn), 1894, *Geo. B. Vasey* (without date); Woodley Park, *L. F. Ward*, Oct. 19, 1884. NORTH CAROLINA: Biltmore, ex Herb. Biltmore, no. *5723-b*, May 10, Oct. 13, 1897; Highlands, *T. G. Harbison 26*, May 18, 1916, *38*, Sept. 24, 1916. OHIO: Steece, *F. W. Dean*, July 13, 1921. KENTUCKY: Echols, Ohio Co., *E. J. Palmer 22542*, May 6, *23699*, Sept. 13, 1923. ALABAMA: Valleyhead, *T. G. Harbison 37*, June 26, 1918. Cultivated in the Arnold Arboretum and in Franklin Park, Boston, Mass.

× **Quercus Schochiana**[1] Dieck (*Q. palustris* × *Phellos*), Nat. Arboretums Zoschen 1894–95. — Schoch. Mitt. Deutsch. Dendr. Ges. 1896, 9. — Rehder, Man. Cult. Trees and Shrubs ed. 2, 156. 1940.

Quercus palustris × *Phellos* Palmer, Jour. Arnold Arb. 2: 143. 1921.

This hybrid was first recognized in the park at Wörlitz, Germany, where it had appeared spontaneously. The name was first published without other description than citation of the supposed parents in a seed list by Dieck, and Schoch had a brief reference to it the following year, as cited above. It has been cultivated in several European gardens, but both the name and the hybrid plants that have lately been found native in several localities in the United States seem to have generally been overlooked by American botanists. Earlier specimens have in some cases been confused with × *Quercus heterophylla*. The leaves are quite variable, but usually resemble more closely those of the willow-oak in size and

[1] Arbor foliis lanceolatis vel oblongo-lanceolatis margine raro integris plerumque undulatis vel incomposite acute lobatis, junioribus infra pubescentibus mox glabris venularum axillis exceptis.

outline. The blades are mostly two to four times as long as wide, from narrowly lanceolate and entire to undulate or lobed with small asymmetric rounded or sharp bristle-tipped lobes, thinly pubescent beneath as they unfold, but soon becoming glabrous except for tufts of tomentum in the axils of the principal veins.

ILLINOIS: Cairo, Alexander Co., *E. J. Palmer 14919*, April 23, 1919, *15090*, May 8, 1919, *16475*, Sept. 18, 1919, *19551*, Oct. 16, 1920, *29648*, Nov. 16, 1925; Mounds, Pulaski Co., *E. J. Palmer 14995*, April 30, 1919; Mound City, Pulaski Co., *E. J. Palmer 15102*, May 11, 1919, *16635*, Oct. 1, 1919; Olive Branch, Alexander Co. *E. J. Palmer 15097*, May 10, 1919; Brookport, Massac Co., *E. J. Palmer 15339*, June 2, 1919. KENTUCKY: Wickliff, Ballard Co., *E. J. Palmer 15108*, May 12, 1919, *16506*, Sept. 20, 1919. ARKANSAS: Dover, Pope Co., *E. J. Palmer 27096*. Cultivated in the Arnold Arboretum and elsewhere in the U. S., Germany, and France.

× **Quercus Smallii** Trelease (*Q. georgiana* × *marilandica*), Proc. Amer. Phil. Soc. 56: 51. 1917; Mem. Nat. Acad. Sci. 20: 17. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 250. 1922.

Quercus georgiana × *nigra* (*marilandica*), Small, Bull. Torrey Bot. Club 22: 75, pl. 233. 1895.

The leaves of the specimens examined somewhat resemble those of *Quercus marilandica* in shape, but are of thinner texture. Small's figures show leaves of a variety of shapes, some of them deeply divided and suggestive of *Q. georgiana*.

GEORGIA: Stone Mountain, De Kalb Co., *J. K. Small*, Sept. 6–12, 1894; Little Stone Mountain, De Kalb Co., *J. K. Small*, Sept. 11, 1894.

× **Quercus stelloides** Palmer (*Q. prinoides* × *stellata*), Jour. Arnold Arb. 18: 139. 1937.

The leaves of the parent species are quite different from each other and the hybrid is well-marked in its intermediate characters. The plants are usually shrubby, from one to two meters tall, but rarely they become arborescent and up to four meters or more. The leaf patterns vary between those of the parent species, but usually they resemble more closely those of *Quercus stellata*, being obovate in outline, with 3–4 pairs of shallow rounded or pointed lateral lobes, simple or rarely enlarged and indented at the apex. At maturity they are green and nearly glabrous above and pale stellate-pubescent beneath.

MASSACHUSETTS: Yarmouth, *M. L. Fernald & Bayard Long 9360*, Sept. 19, 1913; Oak Bluffs, Marthas Vineyard, *E. J. Palmer 45188*, July 4, 1940. NEW JERSEY: Hampton Furnace, Burlington Co., *J. W. Adams 4018*, Sept. 16, 1937; Newtonville, *J. W. Adams 4076*, Sept. 24, 1937; Cape May, *C. F. Austin*, 1899 (G). MISSOURI: Greenwood (Jackson Co.), *B. F. Bush 9744*, Oct. 17, 1921, *10227-a*, Oct. 3, 1923, *10330*, Sept. 5, 1924, *E. J. Palmer 26032*, Sept. 5, 1924. KANSAS: Neodesha, Wilson Co., *E. J. Palmer 21398*, May 23, 1922, *22007* (TYPE), Sept. 18, 1922, *24372*, Oct. 31, 1923. OKLAHOMA: Muskogee, *E. J. Palmer 14285*, June 30, 1918.

× **Quercus sterilis** Trelease[1] (*Q. marilandica* × *nigra*), Proc. Amer. Phil. Soc. 56: 51. 1917. — Sargent, Man. Trees N. Amer. ed. 2, 259. 1922.

Quercus aquatica (*nigra*) × *nigra* (*marilandica*) Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 92. 1894.

[1] Arbor foliis obovatis vel oblongo-obovatis integris vel ad apicem 3–5-lobatis mucronatis subsessilibus supra glabris infra aliquantum pubescentibus; venulis conspicuis. Fructus ovatus; cupula obconica squamis laxis puberulis.

Ashe's description of the tree and specimen on which the name was based was fairly adequate. Trelease in the American Oaks reduced it to synonomy under *Quercus arkansana* which he considered a hybrid of the same parentage. While the leaves of the hybrid and those of *Q. arkansana* are somewhat similar in shape in certain forms, the resemblance is superficial, those of the hybrid differing in their firmer texture and more prominent veins, in the sessile or nearly sessile base, and in the character of the pubescence. Careful study of *Quercus arkansana* in the field and in cultivation at the Arnold Arboretum leaves no room for doubt that it is a good species and not a hybrid.

NORTH CAROLINA: Bladen Co., *W. W. Ashe 246*, June 10, and Nov., 1898. GEORGIA: Climax, *T. G. Harbison 12*, Nov. 6, 1917. TEXAS: Fletcher, Hardin Co., *E. J. Palmer 9556*, April 25, 1916, *10677*, Sept. 10, 1916, *12730*, Sept. 13, 1917, *13103*, March 17, 1918.

× **Quercus Sterretti** Trelease (*Q. lyrata* × *stellata*), Mem. Nat. Acad. Sci. 20: 17. 1924.

This hybrid may be recognized by the shape of the leaves, which are loosely stellate-pubescent beneath and with traces of pubescence at least along the midrib above at maturity. I have not seen the specimen on which the description was based (*W. D. Sterrett*, no. *6*, July 28, 1917, Little Rock, Ark.). Presumably, it was sterile, as no mention was made of the fruit. But on the specimen cited below the immature fruit is peduncled and resembles that of the overcup oak.

ARKANSAS: between Brinkley and Wheatley, Monroe Co., *Delzie Demaree 10883*, Aug. 30, 1934.

× **Quercus subintegra** (Engelm.) Trelease (*Q. incana* × *falcata*), Proc. Amer. Phil. Soc. 56: 52. 1917; Mem. Nat. Acad. Sci. 20: 17. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 266. 1922.

Quercus falcata var. *subintegra* Engelmann, Trans. Acad. Sci. St. Louis 3: 542. 1877.

The original specimen of this hybrid was collected by J. H. Mellichamp near Bluffton, South Carolina, and sent to Engelmann, who believed it to be a hybrid between *Quercus cinerea* (*incana*) and *Q. falcata*. It was first mentioned and described under the name *Q. falcato-cinerea* in the Oaks of the United States, a preprint of the Transactions of the Academy of Science of St. Louis for 1876, and in pages that were later "cancelled" by the author. Engelmann later decided that it was only a variety of *Quercus falcata*, but his first surmise seems to have been the correct one. I have not seen the type specimen, but several later collections listed below appear to belong with it.

GEORGIA: Lumber City, *T. G. Harbison 5*, May 30, 1917, *18*, Nov. 10, 1917; Climax, *T. G. Harbison 2*, May 29, 1917; Decatur, *T. G. Harbison 22*, June 21, 1917; Traders Hill, *T. G. Harbison 7*, April 3, 1918. FLORIDA: Lake City, *T. G. Harbison 22*, June 23, 1917; Ocala, Marion Co., *E. J. Palmer 38304*, March 31, 1931. ALABAMA: Mobile, *T. G. Harbison 4*, Dec. 4, 1919.

× **Quercus sublaurifolia** Trelease[1] (*Q. incana* × *laurifolia*), Proc. Amer. Phil. Soc. 56: 52. 1917. — Sargent, Man. Trees N. Amer. ed. 2, 266. 1922.

Quercus cinerea × *laurifolia* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 89. 1894.

[1] Arbor minor foliis lanceolatis integris vel raro oblongo-obovatis inaequaliter lobatis apice mucronatis maturis subcoriaceis subtus pallidis pubescentibus.

No description or citation of specimens accompanied the publication of this name, but it was doubtless based on Ashe's collection and the publication referred to above, in which a good English description was given. In the American Oaks Trelease reduced it to synonymy under × *Quercus atlantica*. See discussion under that name. A number of specimens that apparently represent this hybrid were found in the herbarium of the Arnold Arboretum under the name × *Quercus dubia* Ashe, as interpreted by Sargent. Some of them are of doubtful relationship and can be distinguished from *Q. laurifolia* only by the presence of stellate pubescence on the mature leaves: others are possibly of a different hybrid origin.

SOUTH CAROLINA: Port Royal, *T. G. Harbison 16*, *17*, Dec. 9, 1917; St. Helens Island, *T. G. Harbison 1*, *2*, Oct. 27, 1917. GEORGIA: Lumber City, *T. G. Harbison 5*, *8*, Dec. 15, 1917, *16*, Dec. 16, 1917; Folkston, *T. G. Harbison 26*, May 15, 1918, *51*, *53*, May 16, 1918. FLORIDA: San Mateo, *T. G. Harbison 1*, *2*, *13*, May 26, 1917, *20*, *22*, *26*, *27*, *28*, Dec. 12, 1917; Orlando, *T. G. Harbison 20*, *21*, *25*, Dec. 5, 1917, *38*, Dec. 14, 1919; Plymouth, *T. G. Harbison 35*, Nov. 13, 1919. ALABAMA: Mt. Vernon, *T. G. Harbison 11*, Nov. 19, 1917.

× **Quercus substellata** Trelease (*Q. bicolor* × *stellata*), Mem. Nat. Acad. Sci. 20: 17. 1924.

I have not seen any material representing this hybrid. According to the description, it was based on a specimen collected by Percy Wilson, at Toms River, N. J., July, 1916.

× **Quercus Townei** hybr. nov. (*Q. dumosa* × *lobata*).

Arbor vel arbuscula ad 5–6 m. alta, ramulis gracilibus annotinis cinereo-viridibus vel brunneis tomentosis lenticulis pallidis conspicuis. Folia persistentia oblonga vel anguste obovata basi cuneata vel rotunda, margine revoluto leviter vel profunde incisa lobis rotundis vel acutis mucronatis subtus sparse stellato-pubescentia. Fructus annuus oblongo-ovatus; glans 2–3.5 cm. longa; cupula hemispherica squamis valde crassis pubescentibus.

Two trees supposed to be this hybrid were found by Mr. Stuart S. Towne, for whom it is named, near Pasadena, California, and a series of specimens with notes was sent by him to Professor C. S. Sargent. The notes stated that *Quercus dumosa* is abundant and extremely variable on the hills in the vicinity of the hybrid, but that *Q. lobata* is not known nearer than about four miles away. The leaves of the hybrid have more resemblance to those of *Quercus lobata* than to those of the other parent, but they are smaller, relatively narrower, and less deeply incised. The acorns are also somewhat intermediate between the two species, with the nut shorter and less pointed than that of *Quercus lobata*.

CALIFORNIA: near Pasadena along La Loma Road, *Stuart S. Towne 1*, *2*, Sept. 23, 1918, (autumn), 1921, 1922.

× **Quercus tridentata** (A. DC.) Engelmann (*Q. imbricaria* × *marilandica*), Oaks of U. S. 18, 1876; Trans. Acad. Sci. St. Louis 3: 539. 1877. — Sargent, Man. Trees N. Amer. ed. 2, 268. 1922.

Engelmann stated that a single tree of this hybrid was found by him in the autumn of 1849, about six miles east of St. Louis, growing in company with the supposed parents. He remarked that the foliage and fruit

characters were such that the origin of the hybrid could scarcely be doubted, that the leaves were rather those of *imbricaria* with a touch of *nigra* (*marilandica*), and that the fruit was more like that of *nigra*. The hybrid is apparently an uncommon one, but specimens that probably belong with it have been found elsewhere within the common range of the parent species. A number of other specimens have been referred to it on account of their somewhat similar leaves with three-lobed apex, but in most cases they appear to belong with either × *Quercus runcinata*, × *Q. heterophylla* or × *Q. Leana*.

ILLINOIS: Richland Co., *Robt. Ridgway 90*, Oct. 1914, *2810*, May 28, 1927; Olney, *Robt. Ridgway*, Feb., 1917, *E. J. Palmer 15584*, June 24, 1919. MISSOURI: Cape Girardeau, *E. J. Palmer 18012*, June 22, 1920.

× **Quercus vaga** Palmer & Steyermark (*Q. palustris* × *velutina*), Ann. Missouri Bot. Gard. **22**: 521. 1935.

Only a single tree of this hybrid is known, and it was found growing with the supposed parent species. The bark and habit resemble *Quercus palustris*, and the leaves are also of the *palustris* type and retain the characteristic tufts of tomentum in the axils of the veins. Traces of easily detached tomentum remain on the young branchlets and on the under surface of the leaves until mid-summer. The scales on the cups of the young acorns are loosely imbricated and pubescent, as in *Quercus velutina*.

MISSOURI: Maryville, *E. J. Palmer 25421*, June 13, 1924.

× QUERCUS VENULOSA Ashe, Jour. Elisha Mitchell Sci. Soc. **41**: 268. 1926.

This name was proposed by Ashe for what he believed to be a hybrid between *Quercus caput-rivuli* and *Q. cinerea* (*incana*). But the former has been reduced to a variety of *Quercus arkansana* (Ashe, Jour. Elisha Mitchell Sci. Soc. **40**: 44. 1924). And Little (33) has pointed out that the name cannot be retained because it is a later homonym of a fossil species, and he prudently suggested that the supposed hybrid should receive further study before it is renamed. An isotype (*W. W. Ashe*, no. *217*, Okaloosa Co., Fla., Nov., 1924) in the herbarium of the Arnold Arboretum shows mature leaves, branchlets, and winter-buds. There can be little doubt of its relationship with *Quercus arkansana* or its variety, but I think there might easily be a question as to the other parent species. There is little except the slightly narrower entire leaves to suggest *Quercus incana*, and it is possible that *Q. obtusa* may have been the other parent.

× **Quercus Walteriana** Ashe (*Q. laevis* × *nigra*), Proc. Soc. Amer. Foresters **11**: 89. 1916. — Sargent, Man. Trees N. Amer. ed. 2, 254. 1922.

× *Quercus sinuata* Engelmann, Trans. Acad. Sci. St. Louis **3**: 400. 1877. — Sargent, Silva **8**: 144, pl. 418. 1895. Not. *Q. sinuata* Walt.?

In proposing this name Ashe called attention to the fact that Engelmann, followed by Sargent, had referred this hybrid to *Quercus sinuata* Walt., which he believed to be the white oak later described by Small as *Quercus austrina*. However, from the brief description given by Walter it does not seem possible to determine the identity of *Q. sinuata*, although it was

probably a hybrid and could scarcely have been *Q. austrina*.[1] So it seems best under the circumstances to accept Ashe's name.

South Carolina: Bluffton, *J. H. Mellichamp*, 1884, May 2, 1890, June, 1894, *C. S. Sargent*, Oct. 4, 1894, *T. G. Harbison 14*, Aug. 29, 1916; Walhalla, *T. G. Harbison 10*, Oct. 11, 1917. Georgia: Lumber City, *T. G. Harbison 17*, Nov. 16, 1917. Florida: Jacksonville, *T. G. Harbison 18*, Dec. 3, 1917.

× **Quercus Willdenowiana** (Dippel) Zabel (*Q. falcata* × *velutina*), in Beissner, Schelle and Zabel, Laubh.-Ben. 67. 1903. — Schneider, Ill. Handb. Laubh. 1: 171. 1897. — Sargent, Man. Trees N. Amer. ed. 2, 257. 1922.

Quercus tinctoria Willdenowinana Dippel, Handb. Laubh. 2: 122. 1922.

× *Quercus Sudworthi* Trelease, Proc. Amer. Phil. Soc. 56: 52. 1917.

This hybrid was described from plants cultivated in Europe, and I have not seen the original material. But plants that apparently belong with it have been found in several parts of the United States.

North Carolina: Biltmore, ex Herb. Biltmore, no. *5723-d*, Sept. 20, 1897. Georgia: Cornelia, *T. G. Harbison 24*, June 30, 1918, *46*, Oct. 1, 1919. Arkansas: Ozark, *Albert Ruth 96*, Sept. 14, 1927.

In addition to the hybrids enumerated and discussed in this list several others are indicated by material in the herbarium of the Arnold Arboretum and other collections. Among these are *Quercus alba* × *lyrata*, *Q. bicolor* × *montana*, *Q. bicolor* × *robur*, *Q. borealis* × *ellipsoidalis*, *Q. borealis* × *marilandica*, *Q. coccinea* × *palustris*, *Q. Durandii* (*austrina*) × *lyrata*, *Q. Durandii* (*austrina*) × *virginiana*, *Q. falcata* × *marilandica*, *Q. falcata* × *nigra*, *Q. hypoleucoides* × *Shumardii* (*texana*), *Q. incana* × *Phellos*, *Q. laevis* × *nigra*, *Q. macrocarpa* × *robur*, *Q. Nuttallii* × *Shumardii*, and others. There is no doubt that most of the specimens are from plants of hybrid origin and in some cases they are more complete and convincing than the types of some of the hybrids that have already been named. But since most of the specimens are without fruit and in nearly all cases there may be room for doubt as to the identity of one of the parents, it seems best to wait for fuller material or for further field study before naming them.

The hybrid oaks afford an interesting field for investigation and the subject is one that is worthy of much more attention. The present paper purports to do little more than to review the subject and to bring together the information already available in a convenient form for study. Many questions of identity and in regard to the variability and the behavior of the different hybrids will not be cleared up until they are approached experimentally and with the aid of cytological study.

[1] See Palmer, Amer. Midl. Nat. 33: 518. 1945.

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A TAXONOMIC REVISION OF PODOCARPUS

I. THE SECTIONS OF THE GENUS AND THEIR SUBDIVISONS WITH SPECIAL REFERENCE TO LEAF ANATOMY

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THIS STUDY of the genus *Podocarpus* stems from a preliminary examination of leaf anatomy. The accounts of Bertrand (1) and Mahlert (10) have yielded conflicting data which seem, after examination of numerous specimens, to be due to the use of material by earlier investigators that had been erroneously identified and to the meagre number of specimens available. With certain corrections, the work of Mahlert (10) appears to furnish a fairly consistent key to the limited number of species considered. Therefore, we began to apply these keys, as corrected, to the species more recently described. We were also inspired by the detailed work of Florin (5) which is confined almost entirely to cuticular anatomy and it seemed that this, in combination with the entire leaf structure, might contribute to a much more accurate classification of species.

Immediately the problem of correctly identifying the specimens found in American collections became a necessity. We have been successful in locating types, isotypes, topotypes and other authentic material of nearly all American species. These provided a sound basis for the comparison of the large number of specimens we had available. All other taxonomic characters shown by the specimens were studied as well and thus it has been possible to render more nearly complete descriptions for many species as well as descriptions of numerous new species and varieties. Hence we are combining the results of our researches on leaf anatomy with the form of presentation used in taxonomic monographs. There is still the shortcoming of having our studies based too largely upon specimens found in American collections, but we have in many instances secured leaf specimens from types and isotypes in European collections and other critically authenticated material, and are therefore enabled to extend our studies and treatment provisionally to collections found in all parts of the world.

A detailed study of leaf anatomy of *Podocarpus* from specimens found in English and Scottish herbaria was made by Orr (11) to determine the value, if any, of these characters in the identification of species. In general our results are in agreement. Unfortunately, in cases of difference, we cannot correlate Orr's work with ours as he does not list the specimens which he examined, and we found the percentage of erroneously named specimens in all herbaria to be extremely high.

Keys based upon leaf anatomy alone lead to all the sections of this large genus. A few individual species may be singled out through leaf anatomy and groups within the sections may also often be recognized by this method. The remaining bulk of the species, then, must ultimately be separated by the usual taxonomic comparison of leaf size and shape, midrib and surface, bud scales, and finally the all-important reproductive characters. Whereas Pilger's keys (12) require a knowledge of reproductive structures at the beginning of analysis of most groups of species, our keys require these details only toward the end of this procedure or in the final determination of species. We feel convinced that our keys to sections and groups of species within sections are very useful due to the abundance of sterile material, and that some of these leaf characters are as important in the definition of sections as the reproductive features which originally formed the entire basis of classification.

DESCRIPTION OF LEAF ANATOMY OF PODOCARPUS

The constancy of internal leaf characters must be demonstrated in the same manner as external characters before they can be used in the determination of groups or species. In using herbarium specimens it must be recognized that methods of collecting and preparing the specimens will alter the color of the leaves, appearance of veins and margins, etc. Mature leaves of the coriaceus type with sufficient sclerids to reinforce the tissues will show a more true character than thin or immature leaves with undeveloped sclerids and cuticle. The internal anatomy of a leaf, easily observed in *Podocarpus* in leaf cross sections, is not changed by collecting methods except in the degree of crushing. But in no case has a thorough study been made of geographical influences on *Podocarpus* and only one or two species (Griffin 8) have been studied in detail in relation to the age of the leaves or the age of the tree or shrub from which the collections were made. Here reference must be made to work on other conifer leaves. An excellent example of such a study is that made by Fulling (7) in *Abies*, and his analysis showed no structural deviations in anatomical features due to sunny or shady portions of a tree, upper or lower portions of a tree, and no correlation with environment. There was only slight variation in positions of resin canals and thickness of hypodermal cell walls, and greater variation in the continuity and abundance of hypoderm. In herbarium specimens he found that the character of the midrib, if at all variable, was practically useless.

A thorough study of leaves from every herbarium specimen of *Podocarpus* available has shown the degree of variation within the species to be small. It has also shown that a single character, such as a large number of vascular sclerids, may be a consistent and distinguishing character in one species or group, while in another species or group it is a character of considerable variation. An analysis of useful anatomical and some external characters follows.

Size of leaf: When a description is based on a single specimen, the variation allowed in the leaves may be entirely inadequate for identification of further specimens. In general, leaves on fruiting branches are smaller, often by half, than other foliage leaves. Extremely large leaves have been collected from seedlings and vigorous shoots of most species.

Midvein: The character of the midvein — prominent or impressed — has been used by taxonomists in species descriptions as a means of differentiation and this procedure has been followed by those identifying herbarium specimens. After careful examination of many leaves in cross section it has been found that it is most valuable when leaves are mature and coriaceous or contain abundant sclerenchyma. The very strict selection of sulcate or prominently ribbed leaves has led to errors in identification in species where it is a variable character, and a number of errors have been made by ignoring the character entirely.

Vascular bundle: The shape is often characteristic in the sections, but little difference among species within the sections has been observed. Figs. 1–5 showing leaf sections include extremes in bundle size and shape.

Transfusion tissue: Transfusion tissue is located on each side of the vascular bundle in a wing formation. It may be a small area (figs. 1 & 7) in sections *Dacrycarpus* and *Stachycarpus*, larger and clear in sections *Sundacarpus* (fig. 2) and *Eupodocarpus* or extend halfway into the blade of the leaf in sections *Afrocarpus* (fig. 3) and *Polypodiopsis* (fig. 4).

Resin canals: Basically there is always one resin canal directly below the vascular bundle. In sections *Sundacarpus*, *Afrocarpus*, *Polypodiopsis* and *Eupodocarpus* (African) it may be flanked by an additional canal on each side. Always in African *Eupodocarpus* (fig. 5) and often in *P. Rospigliosii* (*Polypodiopsis*) there are also resin canals in the extreme margins of the leaves. A special deviation from this pattern will be described under *P. Rospigliosii*.

Accessory transfusion tissue: This tissue has often been described in the literature as, among the Coniferae, it is peculiar to certain sections of *Podocarpus*. It consists of pitted sclerids arranged perpendicular to the vascular bundle in a layer varying in thickness and degree of thickening, extending from each side of the transfusion tissue into the margin of the leaf. This tissue may be entirely absent or replaced by isolated sclerids. Figures 2, 3, 5, 8 and 9 show accessory transfusion tissue. The nature of this tissue has been ably discussed by Worsdell (16) and Orr (11).

Hypoderm: Many previous workers have endeavored to use the size of hypodermal cells, thickness of walls, size of cell lumen, continuity of the layer, number of layers, and length of interruptions in the layers as differentiating characters. We also recognize and use the appearance of the hypoderm, but great care must be observed to state its limitations as many species show it to be variable in one way or another instead of being constant. We believe that variation, when limits are stated, does not detract from its use in indentification. Hypoderm may be seen in figs. 1, 3, 4, 5, 8, 9 and 10.

Sclerids: We now refer to types of sclerids present in the leaves other than those already described as forming distinct tissues.

a. VASCULAR SCLERIDS: Associated with the vascular bundle there are often long fibres with thick walls and almost no lumen. Measurements have shown these to be over a millimeter in length in some cases. They may be scattered around the bundle, only above or below the bundle, arranged as a heavy layer above the bundle or as two small groups on either side of the resin canal. Variation seems to be caused by age of tree and position of the leaf on the tree.

Similar fibres of extreme length and closed lumen are often scattered between hypoderm and palisade on the upper side, or in addition to hypoderm between stomatal rows on lower side, but never form a distinct layer and are very rarely located at margins.

b. AUXILIARY SCLERIDS: In some species palisade cells are altered into pitted, thickened sclerids as shown in fig. 9. They are usually, but not always, much enlarged and the lumen remains large. Mesophyll cells are also sclerified in some species and are distinguished from the palisade sclerids by their position parallel to the cross section of the leaf blade and perpendicular to the palisade; and from the accessory transfusion tissue by their larger size and being shorter and wider. They may form a distinct layer between palisade and accessory transfusion tissue or they may be merely isolated.

Palisade: Except in cases where the palisade consists of two or three layers and shows this thickness consistently, this tissue cannot be used in identifying herbarium specimens. It is altered by light, moisture and age of leaf.

Stomata: Leaves are said to be hypostomatic when stomata are found only on one side (normally abaxially), amphistomatic when they are found on both sides. The latter may be further qualified when more stomata are to be found on one side than the other. Usually arranged longitudinally in rows, the number of rows is a function of the width of the leaf and varies accordingly. The rows may be crowded so as to be scarcely distinguishable, or they may be separated by several rows of ordinary epidermal cells. The subsidiary cell pattern of the stoma was considered in detail by Florin (5). Guard cells are flanked by two to four laterally adjacent and two polar cells and there may be a second rank or partial rank of such cells.

Cuticle: The thickness of the cuticle is an extremely variable character and there is not enough information concerning habitat available on herbarium specimens for correlation with cuticular thickness for this character to be useful except in very special cases.

In the cells of the first rank encircling the stoma, there may be a special furrow in the cuticular thickening forming a complete translucent ring. This was described by Florin (5) and we refer to this character as the Florin ring (compare figs. 11 and 12). Within section *Eupodocarpus* this

character is diagnostic in separating subsections A, C and D from subsection B. It may be present or absent in other sections where the character has been disregarded.

MATERIAL AND METHODS

The method for examination of cross sections of leaves of herbarium specimens of *Podocarpus* is quite simple. The leaf (more than one from different parts of twig or tree if abundant material is available) is soaked in distilled water until it sinks to the bottom of the vial. Then the leaf, or 1–2 cm. lengths from the midportion and base are placed in a split 3 cm.-length of elder pith. The sections are cut by hand with the *new* edge of a safety-razor blade and transferred to 50% glycerine. They may be examined in about an hour or, by evaporating out the water, permanent mounts may be made in glycerine jelly or the sections may be stored in vials in the pure glycerine. No staining of cross sections is necessary for any of the observations made in this paper.

To observe the epidermis, a 3–8 mm. section from the midportion of the leaf is macerated enough to separate the epidermis from the other tissues. The acid is washed out and it is then stained in a 50% solution of safranin. The stained epidermis is cleared and mounted in balsam. Thus the pattern of subsidiary cells of stomates and the Florin ring (fig. 11) as well as epidermal cell arrangement can be seen clearly.

ACKNOWLEDGEMENTS

We are greatly indebted to Prof. Rudolf Florin of Stockholm for obtaining for us leaf samples of numerous species in European collections, and to Dr. J. Wasscher of Beilen, Holland, for an early copy of his monograph on *Podocarpus* (14) and for fragments of numerous type specimens newly described by him. We are also indebted to Dr. Leon Croizat for translations; to Dr. G. N. Jones for critically reading the manuscript. Prof. H. Pittier and Mr. L. Schnee of the Venezuela Herbarium have kindly loaned us certain critical material and sent duplicates of others in the Caracas collections. Mr. J. Soukup of Lima has sent duplicate specimens of several rare species from Peru.

We wish to express our appreciation of the kind cooperation of the curators of herbaria listed below for loans of most specimens in American collections. Herbaria whose collections were studied are cited by employing the following symbols to conform with those given by Lanjouw (9): Academy of Natural Sciences of Philadelphia (Ph), Arnold Arboretum (A), Bishop Museum at Honolulu (Bish), University of California at Berkeley (UC) and Los Angeles (LA), California Academy of Science (CAS), Chicago Natural History Museum (Field Museum) (F), Cornell University (CU), University of Illinois Herbarium (Ill), University of Michigan (Mich), Gray Herbarium (GH), Missouri Botanical Garden (Mo), New York Botanical Garden (NY), University of Tennessee (Tenn), Rutgers University Herbarium (NJU), Stanford University

Dudley Herbarium (DS), United States National Herbarium (US), National Herbarium of Venezuela (Ven), Yale University Herbarium (YU), and Yale Forestry School (Y).

Podocarpus L'Heritier ex Persoon, Syn. 2: 580. 1807, *nomen conservandum*; Endlicher, Gen. Pl. 262, no. 1800. 1837, Syn. Conif. 206. 1847; L. C. & A. Richard, Comm. Bot. Conif. 124. 1826; Blume, Enum. Pl. Javae 1: 88. 1827; Bennett in Horsfield, Pl. Jav. Rar. 35. 1838; Carrière, Traité Conif. ed. 2, 643. 1867; Parlatore in DC. Prodr. 16(2): 507. 1868; Gordon, Pinetum ed. 2, 326. 1875; Bentham & Hooker f., Gen. Pl. 3: 434. 1880; Eichler in Nat. Pflanzenfam. II. 1: 104. 1889; Beissner, Handb. Nadelholzk. 193. 1891; Pilger in Pflanzenreich IV. 5(Heft 18): 54. 1903, in Nat. Pflanzenfam. Nachtr. III, 4. 1906, and ed. 2, 13: 240. 1926; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 262. 1931, 19(2): 8. 1940, in Palaeontographica 85(B7): 577. 1944; Wasscher in Blumea 4: 360. 1941.

Nageia Gaertner, Fruct. Sem. 191. 1788, in part, description confused, *nomen rejiciendum*; O. Kuntze, Rev. Gen. 2: 789. 1891; Baillon, Hist. Pl. 12: 40. 1892.

Myrica sp. Thunb.; *Taxus* sp. Willd.; *Juniperus* sp. Roxb.

Coniferous trees or shrubs, usually dioecious, with large simple leaves, needle leaves or scale leaves, usually alternate (opposite decussate in section *Polypodiopsis*, sometimes subopposite in section *Nageia* and species of section *Afrocarpus*). Leaves amphistomatic or hypostomatic, with or without hypoderm, with transfusion tissue, with one resin canal always below the phloem of vascular bundle and sometimes additional resin canals between this and leaf margin, and as many as vascular bundles in section *Nageia*. Pollen cones cylindrical, terminal (section *Dacrycarpus*) or spicately arranged on lateral branches (section *Stachycarpus*) clustered on special peduncles or solitary, 1–3 fascicled in axils of leaves. Microsporangia 2 on each sporophyll, abaxial, dehiscing with a slit, usually with a centrally placed apiculus of sporophyll; pollen grains usually with 2 air-bladders or wings (or 3 or more in section *Dacrycarpus*). Ovulate cones terminal on short lateral twigs (sections *Microcarpus* and *Dacrycarpus*), or seldom spicate with separated ovules (section *Stachycarpus*), or with 1–2 ovules borne at or near the end of a special axillary fruiting branch, the strobilar axis beneath the seed remaining woody or becoming swollen fleshy at maturity. Ovules inverted, with micropyle near place of attachment, surrounded by and enclosed in an epimatium fused with seed coat except near micropyle and becoming coriaceous or fleshy with the middle layer of seed coat usually indurated, woody, or stony.

SUBDIVISION OF THE GENUS

The divisions of *Podocarpus* by Pilger in 1926 (13) following Engler (4) appears to us to be inconvenient and not well founded. His subgenera *Stachycarpus* and *Protopodocarpus* are each composed of heterogeneous assemblages of categories some of which appear to be more closely related to sections in the alternative subgenus than to each other. To set up additional subgenera in an effort to re-group them might cause more confusion than to list them all as sections. We agree with Wasscher (14) who states on page 361, "I doubt whether the subdivision into sub-genera is right. Perhaps we had better not distinguish any sub-genera, but only six equivalent groups which might be either sub-genera or sections." Our treatment is therefore in full agreement with Wasscher except that we are

adding two other sections for categories mostly outside of the range covered by his treatise. There is only one difference in sectional names: Wasscher's section *Stachycarpus* included plants which we are now placing in the new section *Sundacarpus*. Florin (5), p. 266, also suggested the advisability of such a revision.

The difference in our treatment of this genus and that of Pilger (13) may best be shown by the following outline:

Pilger (1926)	Present treatment
I. Subgen. Stachycarpus Engl.	
A and Ab	7. Stachycarpus Endl., in part.
B	4. Afrocarpus n. sect. 6. Sundacarpus n. sect.
II. Subgen. Protopodocarpus Engl.	
Sect. 1. Dacrycarpus Endl.	1. Dacrycarpus Endl.
Sect. 2. Microcarpus Pilg.	2. Microcarpus Pilger
Sect. 3. Nageia Endl.	3. Nageia Endl.
A. with swollen receptacle	A. with swollen receptacle
B. with woody receptacle	B. with woody receptacle 5. Polypodiopsis Bertrand
Sect. 4. Eupodocarpus Endl.	8. Eupodocarpus Endl.
A. without bracts beneath receptacle	A. African species. C. Central, S. American spp. D. Chile, SW Pacific spp.
B. with bracts beneath receptacle	B. Asia, S. Pacific, Austr.

KEY TO SECTIONS AND SUBSECTIONS

Leaves small, awl-shaped or scale like, amphistomatic, attached spirally.
  Leaves of awl-shaped spreading needles, triangular or 4-sided in cross-section, with hypoderm, single resin canal; when flat, on pectinate frondose twigs of limited growth, giving the plants dimorphic foliage with the flat leaves compressed in vertical plane, ovule and seed with bract as long as ovule and fully incorporated with epimatium throughout its length; receptacle becoming swollen or fleshy as seed ripens (fig. 1.).....Sect. 1. *Dacrycarpus*.
  Leaves of loosely appressed scales, reddish, seed without fleshy receptacle and with bract shorter than seed, free from seed.....Sect. 2. *Microcarpus*.
Leaves large, not awl-shaped needles or scale leaves.
  Leaves relatively broad with many parallel veins and as many resin canals beneath phloem, with hypoderm.....Sect. 3. *Nageia*.
    Leaves amphistomatic, receptacle of seed becoming swollen and fleshy.....Subsect. *A*.
    Leaves hypostomatic, receptacle of seed remaining woody.....Subsect. *B*.
  Leaves with a single median vein.
    Leaves amphistomatic, without accessory transfusion tissue.
      Leaves alternate, spreading on all sides of twigs, seldom sub-opposite, with hypoderm on both sides, with transfusion tissue spread wing like from vascular bundle but without accessory transfusion tissue (fig. 3).....Sect. 4. *Afrocarpus*.
      Leaves opposite, 4-ranked, decussate, but nevertheless usually spread out in a single plane (fig. 4).....Sect. 5. *Polypodiopsis*.
    Leaves hypostomatic, or prevailingly hypostomatic.
      Leaves without hypoderm.

Leaves large, not distichous, 5–16 cm. long (usually 8–11) and 6–14 mm. broad, with accessory transfusion tissue (fig. 2).....Sect. 6. *Sundacarpus*.

Leaves small, less than 3 cm. long and less than 5 mm. wide, usually spread apart in pectinate branches, (a few Old World species or their seedlings may be amphistomatic) without accessory transfusion tissue (fig. 7).....Sect. 7. *Stachycarpus*.

Leaves with hypoderm or hypodermal fibres, or if hypoderm is scanty, leaves with well developed accessory transfusion tissue, seeds with swollen, fleshy, or leathery receptacle.....Sect. 8. *Eupodocarpus*.

Leaves with 3–5 resin canals, a pair of these near margin of leaf, bracts beneath receptacle absent, Florin ring present in subsidiary cells surrounding stomates (fig. 11).....Subsect. *A*.

Leaves with 1–3 resin canals, all at vascular bundle (figs. 5 & 8).

Bracts present beneath receptacle, Florin ring absent (fig. 12).....Subsect. *B*.

Bracts absent beneath receptacle, Florin ring present (fig. 11).

Accessory transfusion tissue well developed (fig. 9).....Subsect. *C*.

Accessory transfusion tissue absent or replaced by sclerids (fig. 10).....Subsect. *D*.

Sect. 1. **Dacrycarpus** Endlicher, Syn. Conif. 221. 1847; Carrière, Traité Conif. ed. 2, 676. 1867; Parlatore in DC. Prodr. 16(2): 520. 1868; Pilger in Pflanzenreich IV. 5(Heft 18): 55. 1903, in Nat. Pflanzenfam. ed. 2, 13: 242, 245. 1926; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 267, 269. 1931, 19(2): 23, 69. 1940, in Palaeontographica 85(B7): 577. 1944; Wasscher in Blumea 4: 386–88. 1941.

Trees or shrubs with small alternate scale like, awl-shaped or flattened leaves, usually amphistomatic, with hypoderm, single resin canal beneath single midvein; dimorphic foliage may include distichous twigs of determinate growth with vertically flattened doubly falcate leaves appearing among branches with awl-shaped leaves, in these the vascular bundle may appear turned with xylem and resin canal on opposite sides of phloem. Pollen cones cylindrical, terminal on short lateral twigs with long apiculate sporophylls resembling leaves, with 2 sporangia; pollen with 3 or more wings. Ovulate cones terminal on lateral twigs with one or two inverted ovules (usually only one developing into seed) with bract adherent to and as long as ovule, becoming consolidated with epimatium throughout its length, the cone axis and sterile bracts below seeds usually becoming warty and fleshy. Southeastern Asia, East Indies and South Pacific Islands to New Zealand.

Sect. 2. **Microcarpus** Pilger in Pflanzenreich IV. 5(Heft 18): 58. 1903, in Nat. Pflanzenfam. ed. 2, 13: 243–245. 1926; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 270. 1931, in Palaeontographica 85(B7): 577. 1944.

Sect. *Dacrycarpus* Parlatore in DC. Prodr. 16(2): 520. 1868, in part; Vieillard ex Carrière, Traité Conif. 697. 1867.

Shrubs with small alternate scale like leaves, amphistomatic. Ovulate cones with small single crested ovule, with its bract free and much shorter than ovule or seed, with strobilar axis below seed not fleshy, but seed enclosed in epimatium surrounding stony seed coat. (*Podocarpus ustus* Brongn. & Gris) New Caledonia.

Sect. 3. **Nageia** Endlicher, Syn. Conif. 207. 1847; Carrière, Traité Conif. ed. 2, 635. 1867; Parlatore in DC. Prodr. 16(2): 507. 1868; Pilger in Pflanzenreich IV. 5(Heft 18): 58. 1903, in Nat. Pflanzenfam. ed. 2, 13: 242, 245. 1926; Florin in

Svenska Vet.-Akad. Handl. ser. 3, 10(1): 272, 274. 1931, in Palaeontographica 85(B7): 578. 1944; Wasscher in Blumea 4: 415. 1944.

Trees and shrubs sometimes monoecious but mostly dioecious with leaves broad, having many parallel veins, either amphistomatic or hypostomatic, with resin canals beneath each of the many vascular bundles. Pollen cones cylindrical, single or several-fascicled at the end of an axillary peduncle. Ovulate cone at the terminal portion of an axillary fertile branch, a reduced strobilus whose scaly, many-noded axis may become fleshy or remain woody. Southeastern Asia, East Indies and Philippines to New Guinea.

Sect. 4. **Afrocarpus** sect. nov.

Sect. III *Stachycarpus* Endlicher, Syn. Conif. 218. 1847, in part; Pilger in Pflanzenreich IV. 5(Heft 18): 63. 1903, in part.

Subgen. *Stachycarpus* (Endl.) Engler in Nat. Pflanzenfam. Nachtr. 21. 1897; Pilger in op. cit. ed. 2, 13: 242. 1926, in part; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10: 266. 1931, as "Artgruppe 2."

Arbores vel frutices dioici foliis magnis planis spiraliter dispositis, amphistomaticis, 1-vascularibus, ducto resinifero unico, fibrosis; strobilis masculis cylindricis, axillaribus, solitariis aggregatisve; strobilis foemineis ramulo squamuloso proprio ligneo fultis; ovulis 1–2, anatropis, epimatio carnoso involucratis, a squamula saepius minore liberis; seminibus globulosis vel piriformibus; strato tegumenti medio indurato.

Africa from equatorial region southward. Type of section: *P. falcatus*.

Sect. 5. **Polypodiopsis** Bertrand in Ann. Sci. Nat. ser. 5, 20: 65. 1874; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 275. 278, pl. 23, 30. 1931, 19(3): 8, 25, 71, pl. 1, 2. 1940, in Palaeontographica 85(B7): 578. 1944; Wasscher in Blumea 4: 423–427. 1941.

Sect. *Nageia* Pilger in Pflanzenreich IV. 5(Heft 18): 58. 1903, in part.

Subgenus *Protopodocarpus* Engler sect. *Nageia* Pilger in Nat. Pflanzenfam. ed. 2, 13: 245. 1926, in part, (B).

Dioecious trees with opposite (4-ranked decussate) foliage. Leaves small, amphistomatic, with single vascular bundle usually flanked by wing like appendages of transfusion tissue (as in *Afrocarpus*), with a resin canal beneath phloem and sometimes several to many other resin canals between center and leaf margin; hypoderm fibres present. Pollen cones cylindrical, 1 — several on the end of a special axillary branch with opposite pairs of scale leaves. Ovulate cone at end of an axillary fruiting branch, bearing terminally a single inverted ovule free from a small subtending bract, epimatium fused with and completely surrounding ovule and seed as part of a fleshy layer, sterile bracts of cone axis below seed scale-like decussate. Seed large, slightly elongated or pear-shaped. South America and South Pacific Islands, New Guinea, New Caledonia and Fiji.

Sect. 6. **Sundacarpus** sect. nov.

Podocarpus sect. 2 *Taxoideae*, Bennett in Horsfield, Pl. Jav. Rar. 40. 1838, in part.

Stachycarpus Endlicher, Syn. Conif. 218. 1847, in part; Pilger in Pflanzenreich IV. 5(Heft 18): 63. 1903, in part.

Subgenus *Stachycarpus* Engler sect. *Nageia* Pilger in Nat. Pflanzenfam. ed. 2, 13: 245. 1926, in part, (B); Wasscher in Blumea 4: 380. 1944, in part.

Arbores dioicae foliis magnis planis spiraliter dispositis; foliis hypostomaticis, hypodermate carentibus, ducto resinifero saepius unico; strobilis masculis cylindricis, axillaribus, apice pedunculi brevis aggregatis; strobilis

foemineis pedunculo constantibus 1–3 ovulis bracteatis donato ad apicem inaequaliter dichotomo, squamulis ab ovulo liberis semper parvis; seminibus anatropis, epimatio carnoso, putamine duro.

East Indies, Philippine Islands, New Guinea, Cape York Peninsula of Australia. Type of section: *Podocarpus amarus* Blume.

Sect. 7. **Stachycarpus** Endl. (emend.), Syn. Conif. 218. 1847, in part; Carrière, Traité Conif. 672. 1867, in part; Parlatore in DC. Prodr. 16(2): 518. 1868, in part; Eichler in Nat. Pflanzenfam. II, 1: 105. 1889, in part; Pilger in Pflanzenreich IV. 5(Heft 18): 63. 1903, in part; Florin, in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 266. 1931, as "Artgruppe 1"; in Palaeontographica 85(B7): 577. 1944, in part.

Prumnopitys Phil. in Linnaea 30: 731. 1860.

Stachycarpus Van Tieghem in Bull. Soc. Bot. France 38: 162. 1891, as genus; Engler in Nat. Pflanzenfam. ed. 1, Nachtr. 21, 1897, as subgenus; Pilger in op. cit. ed. 2, 13: 242. 1926.

Dioecious trees with small spirally arranged leaves spread apart distically in one plane. Leaves of flattened needles usually hypostomatic, without hypoderm, with median vein, with transfusion tissue but without accessory transfusion tissue, a single resin canal beneath phloem. Pollen cones in spicate arrangement on special branches. Ovulate cones consisting of an axis bearing inverted bracted ovules in spicate arrangement on the end of a special fruiting branch of which several or only one may mature as a seed, or in some species only the terminal ovule may develop. Ovule and seed usually covered with soft epimatial layer which may form a distinct crest at the tip farthest from micropyle. Central and South America to New Zealand, Australia and New Caledonia.

Sect. 8. **Eupodocarpus** Endlicher, Syn. Conif. 208. 1847; Bennett in Horsfield, Pl. Jav. Rar. 39. 1838, as sect. 1; Miquel, Fl. Ind. Bat. 2: 1072. 1859; Carrière, Traité Conif. ed. 2, 644. 1867; Parlatore in DC. Prodr. 16(2): 509. 1868; Gordon, Pinetum ed. 2; 326. 1865; Eichler in Nat. Pflanzenfam. II, 1: 104. 1889; Beissner, Handb. Nadelholzk. 193. 1891; Pilger in Pflanzenreich IV. 5(Heft 18): 73. 1903, in Nat. Pflanzenfam. ed. 2, 13: 242, 247. 1926; Foxworthy in Philipp. Jour. Sci. 6: 160. 1911; Stiles in Ann. Bot. 26: 448. 1912; Gibbs in Ann. Bot. 26: 543. 1912; Hickel in Lecomte, Fl. Gén. Indo-Chine 5: 1066, 1931; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 279, 283. 1931, in Palaeontographica 85(B7): 577. 1944; Wasscher in Blumea 4: 427. 1941.

Trees and shrubs, usually dioecious, with alternate leaves arising from all sides of twigs. Leaves flat, hypostomatic, with hypoderm represented, with 1–5 resin canals, transfusion tissue, and accessory transfusion tissue with exceptions. Pollen cones axillary, single or grouped or variously clustered on peduncles. Ovulate cones borne singly on axillary peduncles bearing 1–2 terminal inverted ovules surrounded by epimatium, their subtending bracts separate and small, usually included in cone axis which, with sterile bracts, become a swollen or a fleshy receptacle. Seeds mostly ovoid or globose, frequently with an apiculus at exposed end, with the stony layer relatively thin. Central and South America, Africa, Asia, Australia, South Pacific Islands.

GEOGRAPHIC DISTRIBUTION

Three large areas of the tropics and southern hemisphere are occupied by species of *Podocarpus*. These are:

I. the area from southern Japan and China, Nepal, Sumatra to Australia including Tasmania and New Zealand, thence northward to the Fiji Islands and the Philippines.

II. South Africa and Madagascar extending northward only a few degrees north of the equator.

III. South and Central America northward almost to the Tropic of Cancer including the West Indies.

These three areas are geographically isolated by large oceanic expanses at the Equator and temperate zones and by the frigid zone in the Antarctic. The Indian Ocean and a gap formed by the peninsular part of India (where there are no conifers) separates I and II; the south Atlantic and Pacific Oceans isolate Area III.

In these three major areas the sections of *Podocarpus* are very unequally represented. Section *Eupodocarpus* is found in all of these areas, but the subsections differ. All other sections occupy either only one or parts of two of these larger areas.

Area I includes parts of seven of the eight sections of the genus which are unequally distributed and only two of the four subsections of *Eupodocarpus* which overlap. Within this region sect. *Microcarpus* is known only from New Caledonia, a relatively small island on which representatives of four other sections are encountered. Sections *Nageia* and subsection B of *Eupodocarpus* range farther northward in this area than species of *Podocarpus* anywhere else in the world, crossing the Tropic of Cancer and extending to about 34° N. latitude. The latter subsection covers almost the entire region of Area I excepting Tasmania and New Zealand. (Some of these plants may be cultivated in similar latitudes in the U. S. even though none of the native American species have spread north of the Tropic of Cancer on the American continent.)

In Area I the range of sect. *Sundacarpus* is restricted to the Sumatra-Philippine Islands-New Guinea triangle, overlapping and almost completely surrounded by the sections, *Nageia* and *Dacrycarpus*. The first two of these are not found east or far south of New Guinea, while section *Dacrycarpus* extends to New Zealand.

Australia has four sections represented, none of which is peculiar to this continent. All of them are extensions of the ranges of sections or subsections with extremely wide distributions. The range of section *Stachycarpus*, which touches northeastern Australia extends across the Pacific to South and Central America. Section *Eupodocarpus* is represented in Australia by two overlapping subsections, B and D. The former (B) ranges to China and Japan, and eastward to the Fiji Islands and New Caledonia, but not to New Zealand nor Tasmania, while the latter (D) ranges eastward across the Pacific from southeastern Australia, Tasmania, New Caledonia and New Zealand to Chile.

In Area II (Africa) only two sections are represented. Section *Afrocarpus* is found nowhere else, while subsection A of *Eupodocarpus*, with a similar distribution, includes Madagascar.

In Area III (America) three sections are represented: *Stachycarpus*, *Polypodiopsis* and subsections C and D of *Eupodocarpus*. All of these excepting C of *Eupodocarpus*, range across the south Pacific — *Polypodiopsis* from Venezuela and Peru to Fiji, New Caledonia and New Guinea; *Stachycarpus* from Venezuela and Costa Rica to New Zealand, New Caledonia and Queensland; subsection D from Chile to New Zealand, Tasmania, New South Wales and New Caledonia.

ORIGIN OF PODOCARPUS

The place of origin of *Podocarpus* would seem to be included in Area I where seven of the eight sections of the genus are represented. The tropics of Area I and well into the North Temperate Zone is a region inhabited by many species of Pinaceae, several Taxodiaceae, *Amentotaxus* and *Cephalotaxus*. Hence, if any single general area of the world may be designated, in which several or all of these families of conifers may have had a common origin, it is here where these diverse conifers still overlap. This is of special interest since their origin may go back to the close of the Paleozoic or not later than the early Mesozoic and it is known that there have been major changes in the continental areas since that time.

The conifers, with seeds as their only method of reproduction (before there were land animals other than amphibians and reptiles to aid in seed dispersal) probably spread very slowly. Their species never became truly world-wide. It may be presumed that some Podocarpaceae still occupy very largely the area or general region of their origin (sections *Nageia*, *Sundacarpus*, *Microcarpus*, *Dacrycarpus* and subsection B of *Eupodocarpus*). *Afrocarpus* and subsection A of *Eupodocarpus* may have migrated westward from Area I over land connections during an early period. Other sections such as *Stachycarpus*, *Polypodiopsis* and subsection D of *Eupodocarpus* have, on the contrary, spread themselves over areas incredibly distant, since they now occupy areas that are very far apart, with barriers of the South Pacific between.

The evolution of Podocarpaceae proceeded throughout the Mesozoic. They spread slowly until birds and mammals appeared, which might aid in the dissemination of their seeds. It must be remembered that conifers, cycads, ginkgos and ferns were the dominant land plants up until the sudden appearance of angiosperms in the Cretaceous.

However, Area II, with section *Afrocarpus* and subsection A of *Eupodocarpus*, is far removed from Area I. These areas must have been connected during the early Mesozoic and likewise Area III, which is separated from II by the Atlantic Ocean. Assuming no barriers, the mere spread of the plants of these sections to these areas must have required a long period of time.

There is evidence in leaf anatomy to indicate that sect. *Polypodiopsis* has characteristics in common with sect. *Afrocarpus* — amphistomatic leaves, well developed transfusion tissue into wing like expansions of the vascular bundle with the lack of accessory transfusion tissue (cf. figs. 3

& 4). There is also some evidence in leaf anatomy indicating that subsection C and subsection A of *Eupodocarpus* have a common origin. This is indicated by the Florin ring (fig. 11) which they (along with D) have in common and by the absence of bracts beneath the receptacle (for these details see key to sections and subsections).

The apparent crossing of the South Pacific is also indicated by other genera in this family — *Dacrydium* with one species in Chile, *Araucaria* with two species in Area III and the remaining species in the southern part of Area I. Furthermore, sect. *Dacrycarpus* had a foothold in Chile during the Tertiary. Florin has demonstrated fossils in Chile that may be referred to this section. There are other conifers that appear to have crossed the South Pacific as well as primitive angiosperms.

These extreme migrations of several sections and their descendants which appear to have spanned several oceans in encircling the globe need not be believed if one accepts some form of the Wegener theory of continental drift. However, the sections of the genus must have been very unevenly distributed with their ranges widely diversified on Gondwana before separation of the continents took place. By using the maps given by DuToit (3, figs. 7 and 12, for example) one may account for the origin and dispersal of sections.

According to this, *Afrocarpus* and *Eupodocarpus* A (in Area II) would have come from or had an origin in common with *Podocarpus* of Area I. *Polypodiopsis* in Area III could have been derived from *Afrocarpus* in Area II and spread via Patagonia to New Caledonia and New Guinea. *Eupodocarpus* C could have come from *Eupodocarpus* A, giving rise, in turn, to *Eupodocarpus* D which reached New Zealand and Australia by the same route. The same holds for *Stachycarpus* except that we find some evidence in leaf anatomy to indicate migration in the opposite direction, from Australia and New Zealand via Patagonia to Central America. *Stachycarpus* may have been derived from *Sundacarpus* to which it is related and which has remained in Area I. The Wegener theory, therefore, serves to clear up many of the problems in the distribution of these and other conifers, to which there is no satisfactory alternative answer.

There is also the question as to which section of *Podocarpus* is most primitive. If the choice lies among the sections included in Area I, with seven sections represented, the selection is narrowed so very little that the decision must still be made on the basis of morphological characters. It is possible that some would contend the section *Eupodocarpus* to be one of the more primitive sections due to its wide distribution over all parts of the southern hemisphere. Our basis of judgment in placing this last is founded upon the almost universal hypostomatic condition of the leaves and the well-developed accessory transfusion tissue (absent through loss in the course of evolution only in sub-section D). On the other hand, sections *Microcarpus* and *Dacrycarpus* include the small awl-shaped or scale leaves now known to be characteristic of primitive conifers (Florin 6). Section *Microcarpus* has the bract separated from the ovule which

would indicate that this section is more primitive than sect. *Dacrycarpus*. The latter may be advanced with respect to fusion of cone scale with the ovuliferous scale, represented by the epimatium, but is otherwise, in common with section *Microcarpus*, primitive in having the strobili borne on the ends of ordinary lateral branches rather than specialized fruiting branches. This is the condition shown by Florin (6) for several fossil conifers from the Paleozoic.

It was pointed out earlier by Buchholz (2) that embryologically section *Stachycarpus* in part (now section *Afrocarpus*) and *Nageia* may have the most primitive type of embryogeny. On this basis *Nageia* and *Afrocarpus* would seem to be among the more primitive sections. Furthermore the leaves of section *Nageia* have very much in common with another genus, *Agathis*, of which we have examined a number of species. *Agathis* differs primarily in having the resin canals situated between the vascular bundles rather than beneath them, next to the phloem. Indeed the leaves of sect. *Nageia* and *Agathis* also have much in common with those of certain fossil Cordaitales. Regardless of the precise point of origin in evolution, it appears unlikely from morphological considerations that *Polypodiopsis*, *Sundacarpus*, or *Eupodocarpus* are primitive.

Stachycarpus has been singled out by Wilde (15) as possessing a primitive type of grouping of strobili. This may be correct so far as it concerns the arrangement of pollen cones and seed cones, but not necessarily the origin of the strobilar structure itself. There is still a gap between the specialized branch, bearing cones, and the cone borne terminally at the end of a lateral unspecialized branch. There is the question, therefore, whether the condition of *Dacrycarpus* stands at the end of a reduction series from a specialized branch bearing clustered cones, or whether this solitary terminal cone on an unspecialized branch may not represent a more primitive condition, before specialized branches arose. Wilde treats sect. *Dacrycarpus* as if it were derived from sect. *Stachycarpus*. As we have observed in numerous specimens belonging to sect. *Dacrycarpus*, we are inclined to agree with Wasscher's description of these cones, namely, that they are terminal on short lateral unspecialized twigs in which the leaves of these twigs gradually merge into the little-different microsporophylls.

It may be pointed out that Wilde's (15) arrangement of female cones in the entire series for the genus is realized fully within the sect. *Stachycarpus*, even as we have restricted this category. Here, as she points out, *Podocarpus andinus* and *P. spicatus* show the most primitive condition among living forms, whereas, *P. montanus*, in which only a single ovule (sometimes two) remains to form the seed in a terminal position, represents an end member as extreme as any of the others which she cites. In *P. montanus*, of which we are including views of the female fertile branches (figs. 19, 24, 27), not only is the foliage that clothes this member composed entirely of normal leaves, but even the bract subtending the terminal ovule has become enlarged and leaf-like.

Among the sections, our choice of the most primitive has narrowed down to one of three: *Microcarpus*, *Dacrycarpus* and *Nageia*. All of the others save *Afrocarpus* may be excluded. These three sections are the ones about which least is known morphologically — not even the taxonomic characters are fully understood.

Our order of numbering the sections therefore has little significance. Among the three most primitive we are retaining the order given by Pilger in 1903 (12), very largely as a matter of convenience.

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A TAXONOMIC REVISION OF PODOCARPUS
II. THE AMERICAN SPECIES OF PODOCARPUS: SECTION STACHYCARPUS

JOHN T. BUCHHOLZ AND NETTA E. GRAY

With four plates

SPECIES OF *Podocarpus* belonging to section *Stachycarpus* have small yew-like leaves, spread apart distichously, are without hypoderm, with transfusion tissue, and have no accessory transfusion tissue. They may be distinguished from those of *Taxus* by the presence of the single resin canal, absent in *Taxus*. All American species are hypostomatic, but there are several species in the Old World near the extreme western limit of the range of this section with unequally amphistomatic leaves. (In this region there might be confusion with certain species of *Dacrydium* which are usually not distichous though some are without hypoderm.)

In differentiating the species in this section it has been found that the plants are so similar in leaf anatomy that it is impossible to distinguish the American species from each other through internal differences. The greatest variation is observed in the number of layers of palisade tissue but this character is somewhat subject to ecological conditions such as altitude and exposure. There is no sclerenchymatous tissue, nor isolated sclerids whatever, aside from that belonging to the vascular bundle and its associated transfusion tissue. Externally, some usable differences are readily visible — groove vs. ridge or flat surface above the midvein, size and shape of leaves. But to make positive identification, seed cones and seeds are necessary. Unfortunately, not many of the specimens collected are with seeds. It is therefore possible that some of the varieties may represent distinct species but a great deal of field observation by botanical collectors and foresters is necessary to delimit the natural ranges of the species and varieties, and to amplify the descriptions of the mature trees as well as the reproductive parts.

KEY TO THE NEW WORLD SPECIES OF PODOCARPUS BELONGING TO SECTIONS STACHYCARPUS AND POLYPODIOPSIS

Leaves flat, attached spirally, distichous, linear or oblong-linear, sometimes falcate; with a single midvein and resin canal, without a layer of hypodermal cells, with well developed palisade tissue and with stomates confined to lower (abaxial) surface.....Section *Stachycarpus*.

Leaves flat above or with a slight ridge above the midvein (figs. 13–17, 21, 22).

Leaves nearly flat above, 15–24 mm. long, about 1.5 mm. wide; seeds ovoid, 20 mm. long, 13–14 mm. wide, very little flattened, borne singly or with several on a spike which is a strobilar axis bearing numerous ovules at the time of pollination. South of Equator.....1. *P. andinus*.

Leaves with a slight ridge above the midvein.
Leaves usually 15–24 mm. long, up to 3.5–4.5 mm. wide, falcate; seeds 9–10 mm. long, with a fleshy coat drying as in a plum, the ovules numerous and borne on an axis resembling a spike, as in *P. andinus* (figs. 13, 17, 21–23). North of Equator.....2. *P. Harmsianus.*
Leaves less than 18 mm. long, seldom more than 2 mm. wide; seeds unknown, ovules borne as in *P. andinus* (figs. 14–16), single crested. South of Equator.....3. *P. utilior.*
Leaves with groove above midvein (fig. 20). North of Equator.
Female reproductive branch bearing ordinary leaves fully or nearly same size as foliage leaves; leaves 5–20 mm. long, 2–4 mm. wide, acute or obtuse.
Leaves 12–20 mm. long, 2.5–4 mm. wide, mostly acute; dry seed up to 15 mm. long, 8–10 mm. wide, with single flattened crest 3–4 mm. long (figs. 24 & 25).....4. *P. montanus.*
Leaves 5–12 mm. long, 2–3 mm. wide, mostly obtuse; seed about 12 mm. long, 8–9 mm. wide, bearing 2 distinct, bluntly rounded crests (figs. 27 & 28).....5. *P. montanus* var. *densifolius.*
Leaves 7–14 mm. long, 2.5–3.5 mm. wide, mostly obtuse (groove sometimes broad and open); dry seed about 10–13 mm. long, 6–8 mm. wide, crest of fused spines or appearing single, relatively long and slender (figs. 19, 29–31).....6. *P. montanus* var. *meridensis.*
Female reproductive branch bearing small bracts or scales, leaves 15–25 mm. long, 2.5–3.5 mm. wide; seed 10–11 mm. long with cylindrical crest 2 mm. long (figs. 32–34).....7. *P. Standleyi.*
Leaves ovate, sessile, opposite, 4-ranked but spread out in a single plane; with stomates on both sides, with hypoderm, a single midvein and 3–11 resin canals. .....Section *Polypodiopsis.*
8. *P. Rospigliosii.*

1. **Podocarpus andinus** Poeppig ex Endlicher Syn. Conif. 219. 1847; Gay in Flora Chilena 5: 403. "1849" [1852]; Gordon, Pinetum 351. 1875; Pilger in Pflanzenreich IV. 5(Heft 18): 64. 1903; Reiche in Engler & Drude, Veg. der Erde 8: 63–64. 1907; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10: 262. 1931; Covas in Rev. Argent. Agron. 6: 24. 1939.
Podocarpus spicata sensu Poeppig, Nov. Gen. Sp. 3: 18. 1845, non R. Br.
Podocarpus valdiviana Senilis, Pinaceae 160. 1866.
Prumnopitys elegans Phil. in Linnaea 30: 731. 1860; Carrière, Traité Conif. 682. 1867; Dallimore & Jackson, Handb. Conif. 60. 1923, 1931.
Stachycarpus andina Van Tiegh. in Bull. Soc. Bot. France 38: 173. 1891.
Taxus spicata Dombey ex Gordon, Pinetum 351. 1875.

An evergreen pyramidal tree becoming 12 m. high, though often only a shrub in cultivation, with smooth dark reddish brown bark, extensively branched and with numerous branchlets. Twigs short, subalternate with many leaves, spreading pectinately. Leaves linear, thin leathery, bright green above and glaucescent beneath, straight or only slightly falcate, short-mucronate, or often obtuse at the tip, somewhat narrowed at the base which is fairly broad, with midvein inconspicuous on upper side, much more prominent beneath especially toward the base, 15–24 mm. long and usually 1.5 or less than 2 mm. wide. Pollen cones borne spicately on a special lateral branch 1.5–2.5 cm. long, among leafy twigs; cones divaricate, numerous (12–20), 6–8 mm. long, sessile, in the axils of minute bracts and crowded toward tip of the branch. Microsporophylls with 2 pollen sacs, terminated by a broadly triangular upturned flat tip, with scarious and minutely denticular margin. Seed cone, a greatly modified strobilar axis appearing as a spike on the end of a special branch 2–2.5

cm. long, with leaves below, followed by scales and bearing several (3–5 or more) scattered ovules above in the axils of small bracts with only one or two of them maturing as seeds attached laterally to the strobilar axis. Seeds ovoid, with a stony inner and a fleshy outer layer resembling a drupe, 20 mm. long, 13–14 mm. wide, slightly flattened. Outer fleshy layer dries over the stony layer as in a miniature prune.

DISTRIBUTION: Central to south-central Chile.

SPECIMENS EXAMINED:

CHILE. Valdivia: Cordillera de la Costa, *Poeppig* (†A, US); Union, at banks of stream near Ranco, *Anon.* (US, with pollen cones). Chile, without detailed locality: "Austro-Andina," Feb. 1829, *Poeppig*, ISOTYPE (ex Bernhardi Herb.) (†Mo, †F); *Ruiz 4635* (ex Herb. Lambert; US); *Germain* (†GH, with seeds); *Philippi*, in 1888 (†A, with seeds, NY [fig. 26], US). CULTIVATED: Kew, *Nicholson*, in 1884 (A); *R. N. Parker*, in 1903 (A); Hanover, Muenden, *H. Zabel* (A); Mainau Island, Lake Constance, *Schneider*, Sept. 1903 (A); Silesia, Breslau, *Baenitz*, 1170 (US, GH); "Greendale," *Anon.* (A, with excellent pollen cones); Golden Gate Park, San Francisco, *Walther*, in 1931 (CAS); *Buchholz* in 1942 (Ill.).

Podocarpus andinus was described by Endlicher who attributed the name and description to Poeppig, indicating an earlier report of this entity under the name of *P. spicatus*, a New Zealand species. Later Philippi described the same plant under a separate generic name as *Prumnopitys elegans*. This is clearly a superfluous name, and therefore, illegitimate, but somehow it has persisted as a horticultural trade name and is still in use. Dallimore & Jackson (1923, 1931) place all species of this group under *Podocarpus* except this one, which they describe under a separate genus as *Prumnopitys elegans* Philippi.

2. **Podocarpus Harmsianus** Pilger in Pflanzenreich IV. 5 (Heft 18): 68. 1903; Dallimore & Jackson, Handb. Conif. 47. 1923, 1931; Pittier, in Bol. Cient. y Tecn. Mus. Com. 1: 9. 1927; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10: 262. 1931; Macbride, Flora of Peru, 1 (Field Mus. Nat. Hist. Publ. 351, Bot. ser. 13): 83. 1936; Schnee in Bol. Soc. Venezol. Cienc. Nat. 9: 184–5 (excl. fig. 3 = *P. montanus meridensis*), *in part*. 1944.

An evergreen tree with dark brown scaly bark becoming 15 m. high or higher with a trunk diameter up to 40 cm. Branchlets slender and somewhat loosely leaved. Leaves coriaceous, spirally arranged, distichously spread in one plane, patent, oblong-lanceolate, straight or falcate or somewhat s-shaped, acute or short angustate above and below, narrowly sessile, 15–27 mm. long, 3–5 mm. wide, pruinose when young except at midrib which is obtusely prominent above and less prominent or flat beneath where midvein separates the two bands of stomates. Pollen cones divaricate, about 15 in each spike, up to 10 mm. long and borne in the axils of minute elliptical, acute bracts (these 2 mm. long), surrounded at the base by small imbricated scales. Microsporophylls broad with a large triangular obtuse upturned apex lacerated at the margins, with two laterally placed microsporangia dehiscing laterally and horizontally. Ovulate cones greatly reduced, consisting of a slender modified branch 15–25 mm. long, clothed only with minute scales below (soon deciduous). Strobilar axis

† This symbol preceding the abbreviated name of an herbarium following the specimens examined signifies that the details of the leaves of this specimen have been examined in cross-section.

bearing one or more inverted ovules near tip, attached laterally in the axil of a bract half as long as the ovule. Seed not flattened, only slightly crested and with a thin fleshy outer seed coat not greatly wrinkled in drying.

SPECIMENS EXAMINED:

VENEZUELA: Colonia Tovar (= Tovar in Aragua): *Fendler 1289* Berlin ex Pilger LECTOTYPE; *Fendler 1289*, ISOTYPES (GH with pollen cones, Ph [fig. 13], †Mo); *Delgado 174* TOPOTYPE (†F with seed of *P. Rospigliosii* (?) in pocket, US without seed); *Delgado 206* (†US); Alto de Nor Leon, *Alfredo Jahn* TOPOTYPE with ovulate strobilus [fig. 21] (†US). Distr. Federal: Silla de Caracas, *O. Kuntze 1611* (NY, US, †F); *Steyermark 55146* (F, Ill); *Delgado 338* (Ven).

COLUMBIA: Magdalena: San Lorenzo Mts. near Santa Marta, *Viereck*, Dec. 1922, (†US with seeds and female strobilus in pocket, [figs. 17 & 23] (F). Colombia, without locality: *Karsten 287* (photo.) probably belongs here (F).

CULTIVATED: Guatemala, garden of Don Mariano Pancheco H., *Steyermark 39887* (†F); Venezuela, Colonia Tovar, *Tamayo 1575* [fig. 22] (†Ven); Colombia, Minca, *Bro. Apolinar A625* (†US); *Daniel 3349* (†US).

The differences between the Colombian and Venezuelan specimens of *Podocarpus Harmsianus* seem to be only slight. More intensive study may reveal differences sufficient to warrant a variety. If so, the Venezuelan plants should be considered as representing the typical form of the species.

Pilger cited two specimens under the original description of this species, listed alphabetically — Colombia without locality *Karsten 287* and Venezuela, Colonia Tovar (= Tovar in Aragua), *Fendler 1289*. The first specimen cited has been selected as the type by Macbride for the collection of photographs. This arbitrary choice by Macbride is unfortunate, since the Karsten specimen is sterile, without locality and has now been destroyed with the Berlin collections.

A study of Pilger's description reveals that the whole of the text applies to the Venezuelan plant, for this is the only one that included pollen cones. The Karsten photograph shows longer leaves, suggesting a seedling or juvenile specimen. Only about half of the description could apply to this sheet. Duplicates of the Fendler specimen are found in American herbaria and one of these (GH) includes the reproductive parts. We, therefore, designate *Fendler 1289* as the lectotype of this species.

3. **Podocarpus utilior** Pilger in Fedde, Rep. Nov. Spec. 1: 189. 1905; Weberbauer in Veg. der Erde 12: 74. 1911; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10: 262. 1931; Macbride, Flora of Peru, 1 (Field Mus. Nat. Hist. Publ. 351, Bot. Ser. 13): 84. 1936.

Podocarpus montanus sensu Britton in. Bull. Torrey Bot. Club 16: 13. 1889, not (Willd.) Lodd.

An evergreen tree up to 20 m. or more high with many branches, the branchlets spreading or erect to spreading, very leafy. Leaves borne spirally but spreading out distichously in one plane, crowded, patent, small, thick, linear, coriaceous, often somewhat widest above the middle, acute or obtuse, oblique at base, sessile or very short-petioled, 10–18 mm. long, about 1.5–2.5 mm. broad, midrib slightly prominent above, with streaks beneath, except along the midrib, but not glaucescent. Leaves of seedlings and young trees probably larger. Pollen cones unknown. Seed cones reduced to a special branch 15–30 mm. long surrounded at the base

by a few deciduous scales and ending in a strobilar axis bearing 4–6 bracted inverted ovules in spiral arrangement, the ovules prominently crested with a single spine-like point. Seeds unknown.

SPECIMENS EXAMINED:

PERU: Junin: Tarma, Mt. Yananga, east of Haucapitana, photo. of *type* and fragment *Weberbauer 2114* (†F Neg. no. 11580, fragment from Florin ex Berlin Herb. †, [figs. 14, 15]); Oxapampa, *Soukup 1802* (GH, †US, †Ill with female strobili [fig. 16]). The following sterile specimens may be referred to *P. utilior* mostly on the basis of geography and agreement in leaf structure even though larger: Ayacucho: Ocarrapa, *Killip and Smith 22480* (†A, †F, NY, US); Junin, Pichis Trail, *Killip and Smith 25746* (†US seedling).

BOLIVIA: Yungas, *Rusby 1960* (†NY, Mich); Huainachoirisa, *Williams 1535* (†NY); Santa Cruz: Samaipata, *Carriker* (†Ph, this specimen has no ridge above midvein, is actually somewhat concave-depressed above).

CULTIVATED: Berlin Bot. Gard., *Rehder* in 1885 (A); ex Gord. Herb. (A); Naples, Hort. Bot. Neapol., *Engelmann* in 1868 (Mo).

As the name implies, this tree is locally used as a source of lumber. Figure 20, supplied by Mr. J. Soukup, shows recent logging operations at Oxapampa. These large logs 1.75 m. in diameter are presumably of this species but this is not a certainty since *P. Rospigliosii* is known to occur also in this locality. The latter is a much smaller tree.

While mature seeds have not been available, fig. 15 of the type specimen of *P. utilior* shows some of the ovules beginning to enlarge, bearing single long spine-like crests. Partially enlarged ovules of *P. Harmsianus* have not shown traces of the crested condition. Its mature seeds are crestless or show a very blunt crest; also this tree is not known to approach the size of *P. utilior* shown in fig. 20. The seeds of *P. Harmsianus* which mature are usually subterminal, those of *P. utilior* show several lateral ovules developing.

The leaves of these two species are very similar. Those of *P. utilior* are smaller in general and are much smaller in the type specimen than those of *P. Harmsianus*. Presumably, reproductive branches taken far up near the top of a large tree would have smaller leaves. The collections of *Soukup 1802* are reproductive in the U. of Ill. specimen (fig. 16) and have leaves larger than the type. Presumably the size of the leaf of *P. utilior* varies greatly depending upon the position on the tree and upon the size of the plant, so that shrubby specimens may have much larger leaves than mature trees. In this condition they may be indistinguishable from those of *P. Harmsianus*, but the latter have not been found to be as small as the type of *P. utilior*, on any specimens. .Small seedlings of both of the species have been seen, and have long, relatively slender leaves.

On the assumption that only a single species has been found in Peru, we are including the material of seedlings and shrubby plants collected by Killip & Smith with rather large leaves under *P. utilior*. This decision is also supported on the basis of geography. With no collections before us from central and southern Colombia or Ecuador with a ridge above the midvein of the leaves, we feel convinced that this geographic discontinuity indicates two distinct but closely related species.

Prior to Pilger's monograph (1903) only a single species in this group was recognized. All specimens are referred to *P. taxifolius* = *P. montanus*. No distinction has been made with respect to a groove vs. ridge above the midvein. However, the plant now known as *P. utilior* was found in cultivation in European gardens — this or *P. Harmsianus*. Gordon in the Pinetum (1858 and 1875) describes the species as known to him "with a slight rib along the upper surface." Witness also the cultivated specimens cited above: Rehder in 1885 from the Berlin Botanical Gardens and a specimen from the Gordon Herbarium. Both of these have the ridge.

All early references give Peru as the origin of *P. montanus*. The original type specimen of *Taxus montanus* Willd. has a distinct groove above the midvein, clearly shown in the photograph. These earliest collections actually came from near Loja in Ecuador and from Colombia, not Peru. No Peruvian specimen of *P. montanus* has been found among those available in American collections. However, all plants that agreed with the early descriptions, grown from seeds of Peruvian origin passed under the name of the only described species and it may be inferred that the plant now known as *P. utilior* was actually in cultivation in Europe for more than a half century before *P. utilior* was described.

Macbride included *P. montanus* in his Flora of Peru based upon material collected by Humboldt on Mt. Saraguro across the border in Ecuador. It might, therefore, be encountered in northern Peru but has not been collected there thus far.

4. **Podocarpus montanus** (Willd.) Loddiges, Cat. 37. 1836; Pilger in Pflanzenreich IV. 5 (Heft 18): 67. 1903, *in part*, in Nat. Pflanzenfam., ed. 2, 13: 245. 1926, in part; Dallimore & Jackson, Handb. Conif. 51. 1923, 1931, in part; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10: 262. 1931; Macbride, Flora of Peru, 1 (Field Mus. Nat. Hist. Publ. 351, Bot. Ser. 13): 83. 1936.

Podocarpus montanus var. *diversifolius* Dallimore & Jackson, Handb. Conif. 51. 1923, 1931.

Podocarpus Harmsianus sensu Schnee in Bol. Soc. Venezol. Cienc. Nat. 9: 184–6. 1944, not Pilg.

Dacrydium distichum Don ex Lamb. Pinus, ed. 2, 2: 120. 1828.

Nageia montana O. Kuntze, Rev. Gen. 2: 800. 1891.

Podocarpus taxifolia Kunth, in Humb. and Bonpl., Nov. Gen. 2: 2, pl. 97. 1817; L.C. & A. Richard, Comm. Bot. Conif. 15. 1826; Endlicher, Syn. Conif. 219. 1847; Gordon, Pinetum 288. 1858, 355. 1875, in part; Carrière, Traité Conif. ed. 2, 672. 1867; Parlatore in DC. Prodr. 16(2): 518. 1868; Uribe, Flora de Antioquia Medellin 44. 1940.

Podocarpus Humboldtii Hort. ex Gordon, Pinetum 288. 1858, 355. 1875.

Prumnopitys taxifolia Hort. ex Dallimore & Jackson, Handb. Conif. 51. 1923, 1931.

Stachycarpus taxifolia Van Tiegh. in Bull. Soc. Bot. France 28: 173. 1891.

Taxus montana Willd. Spec. Plant. 4(2): 857. 1805, not Nuttall.

Torreya Humboldti Hort. ex Lindl. & Gord. in Jour. Hort. Soc. 5: 355. 1850; Knight ex Gord. Pinetum 355. 1875.

An evergreen tree up to 25 m. tall with wide-spreading branches bearing numerous alternate branchlets with taxoid foliage. Leaves spirally arranged and spread out distichously in one plane, linear, sometimes oblique or falcate, apex acute, broadly acute or mucronately acute, gradually narrowed at the subsessile base, sub-petioled, 10–18 mm. long, 2.5–3.5 mm.

wide, dark green above, paler beneath, with a distinct groove above the midvein which is slightly prominent beneath between two broad bands of stomates. Pollen cones numerous (up to 25) spicately arranged on the end of a special branch 3–5 cm. long, each cone borne in the axil of a small ovate bract (this 2–3 mm. long). The cones patent about 10 mm. long, sessile toward the end of the special branch but with peduncles up to 3 mm. long in the lowest cones. Microsporophylls broad with a pair of ovoid sporangia dehiscing horizontally, the upturned apex of the sporophylls triangular from a broad base, obtusely rounded with a scarious margin. Pollen 2-winged. Seed cone reduced to the end of a small branch 4–6 cm. long bearing ordinary leaves below, and only a few bracted inverted ovules at its tip, only the terminal ovule developing into a fleshy seed, the strobilar axis not becoming fleshy. Seed ovoid-globose, sessile, 14 mm. long, 8–9 mm. thick, tipped with a single, somewhat flattened crest, the fleshy outer layer wrinkled upon drying.

Type specimen not seen. Plate 97, vol. 2, Humboldt & Bonpland (1817) shows presumed type specimen; locality, according to Kunth: Quindiu Pass (in Colombia near 4° 38′ N. Lat.; 75° 42′ W. Long.)

DISTRIBUTION: central cordillera in Colombia and Ecuador.

SPECIMENS EXAMINED:

COLOMBIA: Cauca, western slopes of Paramo de Moras, *Lehmann 3763* (†US); Musillo, Central Cordillera, *Dawe 747* (NY, US); Caldas, San Felix near Salamma, *Bro. Thomas 2050* (US); Colombia (New Granada) without specific locality: *Rev. Holton* in 1854 ex Torrey Herb. [fig. 18] (†NY); *Triana 511* (†US); *Mutis 641, 3858, 4414* (US); *Bro. Ariste Joseph A897* (†US).

ECUADOR: Loja, between Tambo Cachiyacu and Nudo de Sabinillas, *Steyermark 54472* (F with seeds, [figs. 24 & 25], Ill).

It should be noted that we have included *Dawe 747* bearing the annotation that this is an important timber tree of the central cordillera in Colombia as representative of the species. Dallimore & Jackson mention this Dawe collection under a trinomial *P. montanus diversifolius* (they may have intended *densifolius* Kunth) which has leaves that are shorter than those of Costa Rican collections, but somewhat longer than those of the variety *densifolius* (see below). Unfortunately no seeds are included among the Dawe specimens, which therefore lack the completeness necessary for more definite classification.

The combination *P. montanus* var. *diversifolius* Dallimore & Jackson is a superfluous name, in any case illegitimate whether it belongs under the variety *densifolius* Kunth or under the species.

5. **Podocarpus montanus** var. **densifolius** (Kunth) comb. nov.

Taxus montanus var. (without name) Willd. Sp. Pl. 4(2): 857. 1805.

Podocarpus taxifolia var. β: *densifolia* Kunth in Humb. and Bonpl. Nov. Gen. 2: 2. 1817.

Podocarpus taxifolia densifolia (Kunth) Gordon, Pinetum 289, 1858. 355, 1875; Carrière, Traité Conif. ed. 2, 673, 1867.

An evergreen tree differing from the above species in its more crowded, shorter, more obtuse leaves, 6–12 mm. long, 2–3.5 mm. wide, dark green above, paler but not glaucous beneath; ovules borne as in the above species but double crested. Seeds about 14 mm. long, 8–9 mm. wide, with a pair of blunt crests.

Type specimen not seen; presumed to be *Link* in Berlin Herb., Photograph in Collection of American types in European Herbaria, Neg. #11575, (F).

Type locality: a few authors including Gordon cite Humboldt in giving the Mountains of Saraguro between Ona and Loja by error in Peru; actually this is in Ecuador. Both the species and the variety appear to be found here and in Colombia and have been collected since in the two regions.

SPECIMENS EXAMINED:

COLOMBIA: Bogota, *Purdie*, sent to Hooker about 1849 (ex Bentham Herb.) with ♀ strobilus, seed in packet (†NY [fig. 27]); *Purdie*, sent to Torrey and Gray, no date (NY, G); Cundinamarca, Sibate, shrub or young tree, *Pennell 2436* (Ph, GH, †NY, [fig. 28] US, F).

ECUADOR: Azuay, beyond Sayousi on trail to Cajas, *Penland & Summers 1082* (F).

6. **Podocarpus montanus** var. **meridensis** var. nov.

Podocarpus montanus Pilger, Pflanzenreich IV. 5 (Heft 18): 67. 1903, in part, in Nat. Pflanzenfam. ed. 2, 13: 245. 1926, in part.

Podocarpus Harmsianus Schnee in Bol. Soc. Venezol. Cienc. Nat. 9: 184–5. 1944, not Pilger.

Podocarpus montanus Schnee, ibid. in part.

Semine quam in *P. montano* ejusque var. *densifolio* minore differt; seminis crista saepius processibus spinosis geminis confluentibus efformata, vel processibus totis coalescentibus semen *P. montani* valde diminutum mentiente; foliis *P. montani* var. *densifoli* persimilibus vel statura intermediis, canaliculo per costam interdum magis aperto.

SPECIMENS EXAMINED:

VENEZUELA: Lara, between Buenos Aires and Páramo de las Rosas, *Steyermark 55459* (F, Ill); Trujillo, Cerra de La Mesa de Esmujaque, *Schnee 50* (Ven, †Ill); *Schnee 55* (Ven, †Ill); Merida, Timotes, *Delgado 366* (†Ven [fig. 29]); Arriba de Chachopo, *Schnee 33* (Ven, †Ill); Tachira, below Páramo de la Negra, above La Grita, *Steyermark 57103* (F, Ill TYPE [fig. 19]); *Klugh* in 1944 (†Ven [fig. 30]).

COLOMBIA: Magdalena, Cerro Pintado, Sierra Perija, *Carricker 49* (US).

This variety of *P. montanus* with leaves that are very similar to or intermediate between the species and var. *densifolius* in size, appears to be widely distributed and somewhat more frequently encountered than the others, with an eastward extension to Lara in Venezuela. However, the seed is not intermediate in size, but is smaller, and furnishes a more distinctive characteristic in its crest. The crest is composed of a pair of partially fused spine-like projections, or these spines may be completely fused resembling the seeds of *P. montanus*, but the entire seed is much smaller. Schnee (1944) was led astray by these spines, regarding them as characteristic of the seeds of *P. Harmsianus* Pilg. of which seeds had not been seen thus far; where actually collected, the specimens had been referred to *P. montanus* by some Venezuelan botanists. As shown in our key, *P. Harmsianus* and *P. utilior* have a ridge on the upper side of the leaf, while the members of the *montanus* group have a distinct groove over the midvein. However, this groove may be somewhat open (fig. 7) in the specimens of var. *meridensis*.

It is possible that both the varieties under *P. montanus* should be regarded as distinct species. There is considerable variation among specimens both as to the leaf and seed characters. We feel that careful observation of these characters by foresters and collectors is desirable before establishing these entities as distinct species, and that our treatment of the specimens before us will serve adequately to bring them to the attention of collectors.

7. **Podocarpus Standleyi** nov. sp.*

Podocarpus montanus sensu Pilger in Pflanzenreich IV. 5 (Heft 18): 67. 1903; in Nat. Pflanzenfam. ed. 2, 13: 245. 1926, in part; sensu Standley, Flora Costa Rica, Field Mus. Nat. Hist. Publ. 391, Bot. ser. 18: 64. 1937.

Arbor sempervirens 25 m. alta, ramulis foliosis alternatum patentibus numerosis; foliis linearibus spiraliter dispositis, uno plano patentibus, saepius falcatis, deorsum acutis vel mucronatio-acutis, ad basim gradatim angustatis, late breviterque subpetiolatis, 12–25 mm. longis (pro more 14–18), 2.5–3.5 mm. latis, supra ad costam, manifeste canaliculatis, costa subtus prominente utrinque zona stomatifera notata; foliis hypostomaticis, regione chlorenchymatis subinde cum epidermate finitima (i.e., strato hypodermico nullo), ducto resinfero sub vena unico; strobilis ♂ in ramulo proprio spicatim dispositis, numerosis (ad 20), apicalibus sessilibus, infernis subsessilibus, in anthesi (i.e., pollinis effusi tempore) ca. 10 mm. longis, bracteis minutis ovatis fultis; microsporophyllis latis, sporangiis 2 ovoideis, basi latis, in apicem triangularem excurvatis, margine libero laevi, scarioso, denticulato; microsporangiis transversim dehiscentibus, polline alato; strobilis ♀ in apice ramuli spiralis 15–25 mm. longis fultis, foliis minimis vel squamis praeditis quam foliis eufoliaceis multo minoribus; ovulis inter sessilibus paucis bracteatis, ad apicem ramuli proprii insidentibus in axin strobili confluenti, terminali semen unicum praebenti maturum; seminibus globoso-ovoideis, crista gracili cylindrico-conica 2 mm. longa coronatis, semine toto 10.5 mm. longo, ca. 6 mm. lato, haud complanato, sicco extus tantum minute ruguloso.

SPECIMENS EXAMINED:

COSTA RICA: Volcan de Poas: Mts. of Canton de Dota, *Tonduz 10333*, TYPE, immature ♂, ♀ cones with seed [fig. 33] in packet (†US); *Tonduz 10743*, ♀ cone [fig. 32] (US); *J. D. Smith 6857* (†GH, US [fig. 34]); *Standley 34836* (US); *Haupt* in 1940 (†LA); *Roever 5074* (NJU); La Laguna, *Tonduz 11913* (US); *Standley 42347* (†F, US); San José, Cerro de las Vueltas, *Standley & Valerio 43581* (†F, US); Cartago, Camp Empalme, along Pan American Hy., *Little 6030* (F).

In describing *P. Standleyi* we are restricting Pilger's description of *P. montanus*. Pilger had broadened the description in including Costa Rican plants. The seed is much smaller than in *P. montanus*, has a cylindrical spine-like crest, and is borne on a specialized reproductive branch which has only scales rather than foliar leaves. Compare figs. 32 and 33 with figs. 24 and 25. The leaves of *P. Standleyi* become much larger and are very glaucous beneath. (fig. 34).

* Named in honor of Paul C. Standley, Curator of the Herbarium, Chicago Natural History Museum, in recognition of his outstanding contributions to our knowledge of the flora of Costa Rica.

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EXPLANATION OF FIGURES

All photomicrographic illustrations of leaf sections for this investigation were made from unstained leaf sections cut free hand from the leaves of herbarium specimens, mounted in glycerine. Figures 11 and 12 showing the presence and absence of the Florin ring (Fl) are exceptions which were removed after maceration and stained with safranin, mounted in balsam, outer side up and photographed under high magnification.

Symbols: *e*, epidermis; *h*, hypoderm; *sc*, sclerid; *p*, palisade tissue; *r*, resin canal; *tr*, transfusion tissue; *act*, accessory transfusion tissue; *Fl*, Florin ring.

PLATE I

Fig. 1. *Podocarpus Cummingii* Parl. *R. M. Holman 0004* (DS). Transverse section of leaf showing epidermis and hypoderm interrupted by stomates on both sides of leaf. This leaf is flattened vertically and has stomates in rows of 2–5 on 4 sides. Resin canal (*r*) beneath vascular bundle is large, bundle has a very small amount of transfusion tissue at the right and left and there is no accessory transfusion tissue. × 48.

FIG. 2. *Podocarpus amarus* Blume. *C. E. Lane-Poole* s.n. (A). Transverse section of central portion of leaf, showing absence of hypoderm with palisade layer abutting heavily cutinized epidermis. The large vascular bundle shows well developed transfusion tissue (*tr*) and accessory transfusion tissue (*act*), the latter extending to the margin of the leaf.

The air chambers found below near the resin canal (*r*) might be confused as additional resin canals, which our sections have usually shown to be single. Stomates are confined to lower (abaxial) surface. × 48.

FIG. 3. *Podocarpus falcatus* (Thunb.) R.Br. *Whitford 27* (US). Transverse section of leaf showing epidermis and hypoderm (*h*) interrupted above and below except at margins and midvein, with large wing-like expansions of transfusion tissue (*tr*) extending nearly halfway to leaf margin but without traces of accessory transfusion tissue. Vascular sclerids are shown above and below bundle and a single resin canal (*r*) near phloem. Stomates are equally distributed on both sides of leaf. × 48.

FIG. 4. *Podocarpus Rospigliosii* Pilger. *Archer 541* (US). Transverse section of lower portion of half of leaf, showing epidermis and interrupted hypoderm. There are stomates on both sides of leaf. The vascular bundle with 3 resin canals (*r*) below, shows (as in FIG. 3) wing-like expansions of transfusion tissue (*tr*) and is likewise without accessory transfusion tissue. × 48.

FIG. 5. *Podocarpus elongatus* L'Herit. Transverse sections of midvein and half of leaf showing epidermis (*e*), hypoderm (*h*) continuous above, interrupted below where the stomates are found. Vascular bundle shows a single resin canal with well developed vascular sclerids below phloem. Transfusion tissue (*tr*) is found on each side of vascular bundle; accessory transfusion tissue (*act*) extends toward margin of leaf where a marginal resin canal (*r*) may be seen. × 48.

FIG. 6. *Podocarpus Totara* D. Don. *R. J. Matthews* s.n. (UC). Transverse section of half of leaf showing continuous hypoderm above, interrupted below, where the stomates are found. The palisade tissue is developed only on upper side. There are no accessory sclerids of any kind; resin canal (*r*) is single near vascular bundle; transfusion tissue (*tr*) is present at left and right of bundle but no accessory transfusion tissue is present; instead the mesophyll cells are slightly elongated. × 48.

PLATE II

FIG. 7. *Podocarpus montanus* var. *meridensis* Buchh. & Gray. *Klugh* s.n. (Ven). Transverse section of central portion of leaf showing epidermis, absence of hypoderm, and well developed palisade tissue bordering directly upon epidermis. Stomates are confined entirely to lower surface of leaf. Vascular bundle has no sclerids; has only small areas of transfusion tissue (*tr*) and no accessory transfusion tissue or sclerids of any kind. This leaf has a groove above midvein, much more open in this variety than in most leaves of the *montanus* group. × 48.

FIG. 8. *Podocarpus macrophyllus* (Thunb.) D.Don. Cult. Jamaica. Transverse section of central portion of leaf showing hypoderm above and below, interrupted above where there are no stomates and absent below except at leaf margin and beneath midvein. Vascular bundle with transfusion tissue (*tr*) and well developed accessory transfusion tissue (*act*) which extends to margin of leaf. There are three resin canals (*r*) beneath vascular bundle but no vascular sclerids or other accessory sclerids. × 48.

FIG. 9. *Podocarpus oleifolius* (?) *Steyermark 53431*. Transverse section of leaf at one side of vascular bundle, showing epidermis and continuous hypoderm above (at right) interrupted hypoderm below (at left) where stomates are confined, and accessory transfusion tissue (*act*) at center. The palisade tissue shows several palisade and accessory sclerids (*sc*) in mesophyll below palisade layer. × 48.

FIG. 10. *Podocarpus nubigenus* Lindl. *C. Junger 73* (Mo). Transverse section near vascular bundle showing hypoderm continuous above, below only at midvein and interrupted elsewhere below where stomates occur; a single resin canal (*r*) beneath vascular bundle, with transfusion tissue on each side but no accessory transfusion tissue. In the position of the latter several large sclerids (*sc*) are shown. × 48.

FIG. 11. *Podocarpus oleifolius* (?) *Steyermark 53431.* Part of lower epidermis after maceration stained and mounted under high magnification, showing the Florin ring (*Fl*) a thin furrow giving a non-staining circle in the cuticular layer above subsidiary cells. × 212.

FIG. 12. *Podocarpus novae-caledoneae* Vieill. *Franc 96* (LA). Lower epidermis, same treatment as FIG. 11 showing absence of Florin ring. × 212.

FIG. 13. *Podocarpus Harmsianus* Pilger. *Fendler 1289* (Ph.). Specimen from lectotype collection showing leaves with ridge above midvein. × 2/3.

PLATE III*

FIGS. 14–16. *Podocarpus utilior* Pilg. FIGS. 14 and 15 parts of photograph of type specimen *Weberbauer 2114* (F) enlarged to natural size. FIG. 16 *Soukup 1802* (Ill) bearing female cones.

FIG. 17. *Podocarpus Harmsianus* Pilg. *Viereck* in Dec. 1922 (US) showing female cones and numerous ovules near time of pollination, mature seeds and leaves with ridge above midvein.

FIG. 18. *Podocarpus montanus* (Willd.) Lodd. *I. F. Holton* in 1854 (NY) showing leaves with groove above midvein and spicate arrangement of pollen cones.

FIG. 19. *Podocarpus montanus* var. *meridensis* Buchh. & Gray. *Steyermark 57103* type (Ill.) Leaves have groove above midvein (lower sides shown here) and seeds borne at ends of leafy branches.

PLATE IV*

FIG. 20. Logging operations at Oxapampa, Peru, showing very large trees, presumably *P. utilior* Pilg. Photo. supplied by J. Soukup.

FIGS. 21–23. *Podocarpus Harmsianus* Pilg. FIG. 21 *Jahn s.n.* (US). Nor Leon (near Tovar in Aragua) female cones past time of pollination with ovules dropped away, only one subterminal ovule remaining, the special branch having scale leaves. FIG. 22 *Tamayo 1575* (Ven.) from a cultivated specimen, at Tovar in Aragua (type locality) showing crestless seed appearing terminal, actually sub-terminal. This twig exposes lower sides of leaves. FIG. 23 *Viereck* in Dec. 1922 (US) from Colombia for comparison with FIG. 8.

FIGS. 24–25. *P. montanus* (Willd.) Lodd. FIG. 24 *Steyermark 54472* (Ill) from Ecuador near Loja showing large leaves with groove above midvein, fruiting branch with seed in terminal position and detached seeds.

FIG. 25. Seeds with flat crests, same collection (F).

FIG. 26. *Podocarpus andinus* Poeppig. Seeds from packet of *Phillipi* in 1888 (NY).

FIGS. 27–31. *Podocarpus montanus* var. *densifolius* (Kunth) Buchh. & Gray.

FIG. 27. *Purdie s.n.* (NY) showing leafy reproductive branch bearing 2 double crested ovules and a full grown seed with 2 distinct blunt crests.

FIG. 28. *Pennell 2436* (NY) showing foliage. Seeds from western Venezuela.

*All figures 7/8 natural size.

FIG. 29. *Delgado 366* (Ven.). FIG. 30 *Klugh* (Ven.). FIG. 31 *Steyermark 57103.*

FIGS. 32–34. *Podocarpus Standleyi* Buchh. & Gray. FIG. 32 *Tonduz 10743* (US) showing leaves and female cone, clothed with scales rather than leaves. FIG. 33 *Tonduz 10333 type* (US), seed with crest and conical cylindrical spine. FIG. 34 *J. D. Smith 6857* (US) showing large leaves with lower surface glaucous.

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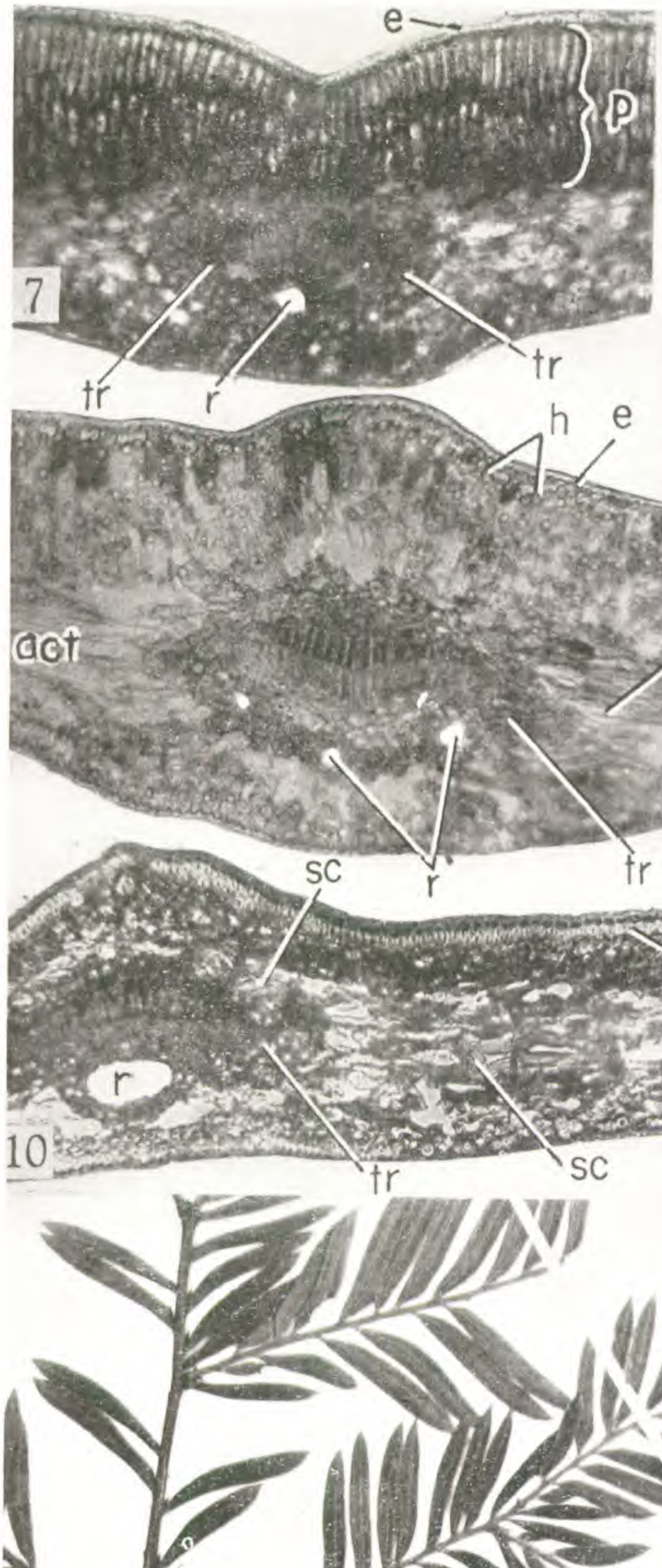
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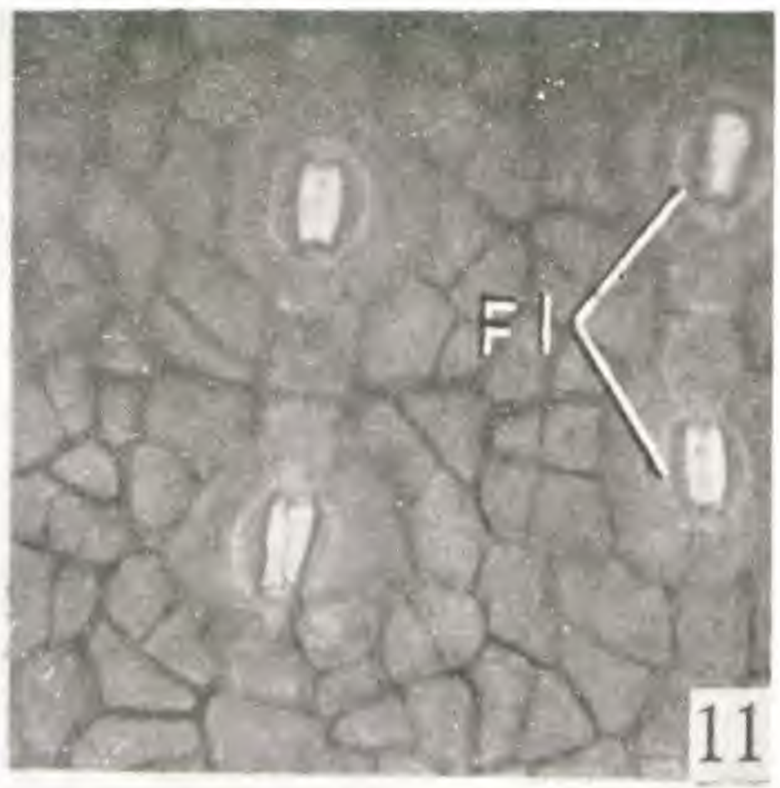
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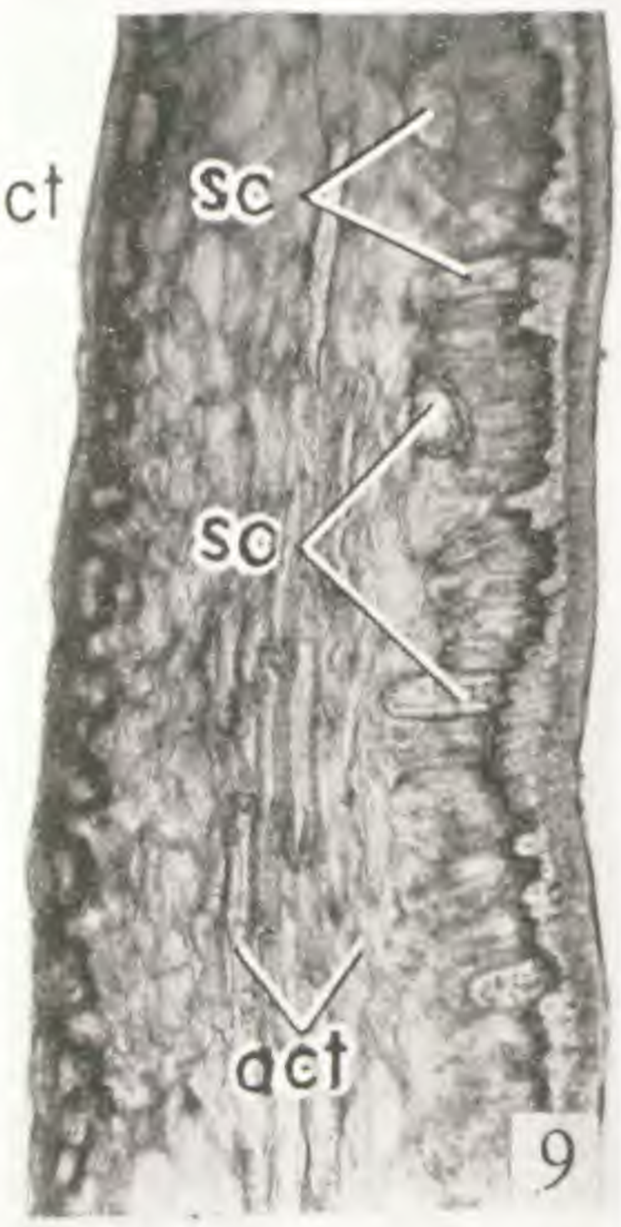
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REVISION OF PODOCARPUS

MORPHOLOGY AND RELATIONSHIPS OF ILLICIUM, SCHISANDRA AND KADSURA

I. STEM AND LEAF

I. W. Bailey and Charlotte G. Nast

With six plates

INTRODUCTION

In a previous paper (1), we called attention to the fact that plants of general ranalian affinities may be divided upon the basis of their pollen morphology into two major categories, viz. (1) those resembling many monocotyledons in having monocolpate pollen or pollen phylogenetically derived from such types of microspores and (2) those resembling most dicotyledons in having tricolpate or derived types of pollen. All plants of the former category, with the exception of the aquatic Cabomboideae and Nymphaeoideae, have secretory cells of a fundamentally similar type. Such "resin" or "ethereal oil" cells do not occur in the second category of ranalian plants, except in *Illicium*, and the Schisandraceae. The secretory idioblasts of *Tetracentron* are of a different morphological type, being elongated and not infrequently ramified.

Since *Illicium*, *Schisandra* and *Kadsura* exhibit evidences of relationship to both major categories of ranalian plants and may prove to be significant in future discussions of the phylogeny of the dicotyledons, it is desirable that the three genera be re-examined from a broad morphological point of view. Material recently assembled by our colleague, Dr. A. C. Smith, for taxonomic revisions of *Illicium* and the Schisandraceae, has provided accurately identified specimens for such investigations. We have examined 34 of the 42 species of *Illicium*, 22 of the 25 species of *Schisandra*, and all of the 22 species of *Kadsura* recognized by Dr. Smith (9).

STEM: XYLEM

The young stem of *Illicium* is characterized by its unilacunar nodes, each leaf having at its base an arc-shaped strand of vascular tissues that is related to a single broad parenchymatous lacuna in the vascular cylinder of the vegetative axis, *Fig. 1*. The later-formed primary vascular elements of the internodal parts of the stem — in contrast to those of the Degeneriaceae, Himantandraceae, Magnoliaceae, Winteraceae, *Trochodendron*, *Tetracentron*, and *Euptelea* — are not aggregated in discrete bundles that are separated by conspicuous parenchymatous, interfascicular parts. The primary xylem tends to be more or less loosely and uniformly dis-

tributed in a pseudo-siphonostelic rather than in a typically eustelic-appearing arrangement.

The rays of the first-formed secondary xylem are uniseriate, vertically extensive and composed of "upright" cells, *Fig. 9*. Subsequently, certain of the ray initials of the cambium divide anticlinally, leading in later-formed wood, *Fig. 10*, to the transformation of parts of the original uniseriate rays into low, biseriate, triseriate or occasionally quadriseriate rays in which the long axis of the constituent cells is radially instead of vertically oriented, compare *Figs. 7* and *10*. Thus, the wood of older stems, in contrast to that of ordinary herbarium specimens, is characterized by having a typically "heterogeneous" type of ray structure. As demonstrated by Kribs (8) and Barghoorn (2), a commonly occurring trend of structural specialization in dicotyledons involves reduction or elimination of multiseriate rays. In *Illicium*, this trend of specialization has progressed to a level where multiseriate rays are eliminated from the first-formed secondary xylem and are reduced in width and height in the later-formed wood. The distribution of the wood parenchyma is transitional between diffuse and scanty abaxial paratracheal, *Fig. 7*.

Although the rays and the wood parenchyma of *Illicium* exhibit conspicuous evidences of phylogenetic modification, the tracheary elements are of relatively primitive types. The long, slender, thin-walled, angular vessel members have extensively overlapping ends with numerous bars in their scalariform perforation plates. The pitting between vessels, and between vessels and parenchyma, is scalariform with transitions to opposite-multiseriate. The imperforate tracheary elements have conspicuous bordered pits and are essentially thick-walled tracheids from a morphological point of view. The vessels are diffusely distributed throughout the secondary xylem, pore multiples being of infrequent or sporadic occurrence. Where growth layers are clearly differentiated in the secondary xylem, the vessels of the earlywood may be somewhat larger than are those of the latewood, *Fig. 7*.

The young stems of *Schisandra* and *Kadsura* have unilacunar nodes, but differ from those of *Illicium* in forming tripartite foliar traces, *Fig. 4*. The internodal parts of the stems exhibit a wide range of variability both in the arrangement of the primary xylem and in the detailed structure of the secondary wood. In certain of them, *Fig. 14*, the primary xylem occurs in relatively widely spaced strands, i.e., in a typically eustelic arrangement; whereas in others, *Fig. 13*, the vessels of the last-formed primary xylem appear as a continuous ring, i.e., in transverse sections of the internode.

The secondary xylem may be dense and of a relatively primitive structural type, *Fig. 14*, or it may be of a highly specialized and extremely porous type such as occurs commonly in many scandent plants, *Fig. 8*. The first-formed secondary xylem frequently is of the former type, transition to increasing porosity occurring during subsequent stages of the enlargement of the stem, *Fig. 14*. In other cases, the cambium first forms a narrow zone of nearly vesselless xylem which is succeeded by an abrupt

and precocious transition to a conspicuously porous type of wood, *Fig. 13*. Certain stems exhibit more or less clearly defined zones of alternating density and porosity.

As indicated in *Fig. 14*, the inner zones of unmodified secondary xylem are characterized by having slender diffusely scattered vessels, thick-walled tracheids, multiseriate rays that extend outward from the interfascicular parts of the eustele and numerous intervening high-celled uniseriate rays. The distribution of wood parenchyma is scanty diffuse and abaxial paratracheal. Such secondary xylem — allowing for differences due to its ontogenetic position — resembles the wood from older stems of *Illicium*, compare *Figs. 7* and *14*, but a majority of its vessels differ from those of *Illicium* in having a reduced number of bars and enlarged openings in their scalariform "perforation plates." Vessel members exhibiting early stages of their phylogenetic derivation from scalariformly pitted tracheids are, however, of not infrequent occurrence. In contrast to this relatively primitive type of secondary xylem, the highly specialized porous type of wood illustrated in *Fig. 8* is characterized by its huge vessels, its large, thin-walled, profusely pitted tracheids, and its more abundantly developed paratracheal parenchyma. In structurally more specialized stems, the rays of the first-formed secondary xylem are prevailingly uniseriate, *Fig. 13*, certain of them subsequently broadening to multiseriate rays. The larger vessels have perforation plates with a single large circular or oval opening. The pits between such vessels and parenchyma are conspicuously enlarged, having large apertures and more or less vestigial borders on the vessel side. Where vessels are in contact, the pitting is scalariform or transitional to opposite. Alternating seriations of bordered pits occur at times between vessels and tracheids.

It is evident, accordingly, that the xylem of *Illicium* is of a relatively uniform and stable type. On the contrary, the wood of *Schisandra* and *Kadsura* exhibits a wide range of structural variability, as is so commonly the case in scandent plants. Conspicuous structural differences occur not only in stems of different species, but also in different stems from presumably the same species and even in different shoots of the same plant. A wealth of specially collected material must be examined before it will be possible to determine the exact significance of anatomical criteria in differentiating species and varieties. Such intensive investigations of the scandent schisandras and kadsuras should prove, however, to be extremely significant from both morphological and physiological points of view.

STEM: PHLOEM

In addition to rays, the recently formed phloem of *Illicium* consists of numerous contiguous sieve tubes among which are scattered companion cells, phloem parenchyma strands and cambiform cells of a special type. The long, slender sieve tube members have extensively overlapping ends with numerous, often widely separated, sieve areas. The cells of the rays and of the parenchyma strands have large vacuoles that contain a high

ratio of tannin or other phenolic compounds. The cambiform cells have layered "mucilaginous" contents which expand rapidly in water and stain intensely with ruthenium red. As a stem increases in diameter, sclereids tend to be formed sooner or later in the older, outer secondary phloem. These more or less ramified stone cells may be diffusely scattered or they may be aggregated in compact masses of varied form. Slender, thick-walled fibres are confined to the primary body and when present in the stem are diffusely scattered about the outer periphery of the stele in the so-called pericyclic zone.

The phloem of *Schisandra* and *Kadsura* resembles that of *Illicium* in containing numerous elongated or cambiform elements with stratified "mucilaginous" contents. The "mucilage cells" of the first-formed phloem commonly tend to become more or less extensively dilated, *Fig. 12*, in contrast to those of the subsequently formed secondary phloem which retain a more slender form, as in the phloem of *Illicium*.

There is a more precocious development of sclerenchyma in the secondary phloem of *Schisandra* and *Kadsura* than in homologous tissue of *Illicium*, and the more or less extensively clustered, thick-walled, lignified elements are of an entirely different morphological type. In contrast to the ramified stone cells of *Illicium*, the sclerenchymatous elements of *Schisandra* and *Kadsura* are of a linearly elongated and fiberlike form, *Fig. 26*. As noted by Solereder (10), the thick, lamellated, unpitted secondary wall of these cells develops asymmetrically, gradually crowding the protoplast laterally toward the periphery of the cell, *Fig. 23*. During the last stages of secondary wall formation, numerous crystals of calcium oxalate become encysted in the outer surface of the cellulose adjacent to the constricted protoplast. This asymmetry in the development of the secondary wall and in the distribution of crystals occurs characteristically in the sclerenchymatous elements of all species of *Kadsura* and *Schisandra*. As will be shown on subsequent pages, diversified forms of this crystal-bearing sclerenchyma occur more or less abundantly in the cortex and pith of the stem, in the leaf and the flower, and thus are a significant diagnostic characteristic of the Schisandraceae.

"Pericyclic" fibers are more abundantly developed in the Schisandraceae than in *Illicium*. They differ markedly from the crystal-bearing sclerenchymatous elements of the secondary xylem, having normal symmetrically developed walls, and being conspicuously pitted and septate. They commonly appear as a more or less continuous zone or ring in cross sections of young stems. However, this ring of "pericyclic" fibers becomes disrupted into disconnected arcs or strands during subsequent enlargement of the stem. Not infrequently the earlier breaks in the "pericyclic" ring become occluded by crystal-bearing sclerenchymatous elements of bizarre forms.

STEM: CORTEX AND PITH

Three types of idioblasts are of more or less frequent occurrence in the cortex and pith of *Illicium*. Globular "resin" or "ethereal oil" cells,

having a tenuous "suberized" inner membrane which stains in sudan IV, occur commonly in the cortex. They vary considerably in size and number. "Mucilage" cells of diversified size and form and of fluctuating abundance may be formed in both the cortex and the pith. More or less conspicuously branched sclereids occur at times in the cortex or in both the cortex and the pith.

The cortex and the central part of the pith are badly collapsed in most herbarium specimens of *Schisandra* and *Kadsura*, and, therefore, are poorly preserved for anatomical investigations. It is evident, however, that globular "ethereal oil" cells are of common occurrence in the cortex, *Fig. 12*, and that "mucilage" cells frequently are present in the succulent central core of the pith. Furthermore, crystal-bearing sclerenchymatous elements are formed in the cortex and not infrequently in the pith. These cells fluctuate widely in size, form, and number in different stems. They may be abundantly developed throughout the cortex and pith of the internodal parts of the stem or they may be few in number and confined to the nodal parts.

LEAF: EPIDERMIS AND STOMATA

Throughout the genus *Illicium* the lateral walls of the lower epidermis, as seen in surface view of the leaf, are conspicuously pitted and undulating, *Fig. 11*. It should be noted in this connection, however, that drying and reagents which tend to contract the epidermis may accentuate the undulations, whereas treatments that excessively reexpand the cells and cell walls reduce or eliminate the wavy outlines. The lateral walls of the upper epidermis may be either smooth or undulating.

The cuticle of the under surface of the leaf is commonly characterized by having parallel, ridge-like thickenings. These projections of the outer surface of the cuticle, *Fig. 11*, may be coarse and conspicuous or very fine and easily obscured in preparing leaves for microscopic examination. They are distributed in specific patterns, e.g., oriented parallel to the long axis of the mid-rib and the larger veins, concentrically about the stomata and radially in the rosettes of cells surrounding the secretory cells of the lower epidermis, *Fig. 11*. They may be uniformly distributed, or confined to restricted areas, viz. about the stomata, the secretory cells, or the larger veins. Ridge-like thickenings of the cuticle may occur also on the upper surface of the leaf.

According to Solereder (10), the stomatal guard cells of *Illicium Griffithii* (?) and *I. religiosum* (?) have lobe-like appendages that are oriented along extensions of the major axis of the aperture. Similar structural appearances occur in nearly all of the 73 collections of *Illicium* examined by us and, therefore, are characteristic of the genus. When the lower epidermis is examined unstained in surface view, the stomata exhibit a deceptive, superficial resemblance to those of Gramineae, see Haberlandt (7), where the guard cells are shaped like dumb-bells, having dilated thin-walled ends connected by a slender very thick-walled part. The lobe-like

appearances are also suggestive of the lightly cutinized polar areas in Bennettitalean stomata, see Florin (5).

That the stomatal apparatus of *Illicium* is actually of a fundamentally different type may be demonstrated, however, by examining strips of the epidermis and thin transverse sections of the leaf that have been stained with sudan IV.[1] In such preparations, the hypothetical lobe-like appendages prove to be tapered, intercellular intrusions of the cuticle between the constricted ends of the guard cells, compare *Figs. 16* and *17*. When the stomatal apparatus is examined in surface view at upper focal levels, these intrusions are seen to be in continuity with broad arcs of cutin which project inward between the guard cells and adjacent epidermal cells, the combined cuticular intrusions resembling a head with a broad-brimmed hat, *Fig. 17*. These intercellular intrusions of the cuticle fluctuate considerably in form as seen in surface and sectional views, but tend to be massive except in *I. floridanum* Ellis and certain collections of *I. parviflorum* Michaux, where they are reduced to tenuous wedges of cutin. In surface view, the outlines of the paired guard cells vary from narrowly to broadly elliptical, the dimension of the major axis fluctuating from 30 to 70 microns with corresponding variations in the minor axis. Each pair of guard cells is accompanied by 2 to 4 subsidiary cells oriented parallel to them, *Fig. 17*. These subsidiary cells appear to have been derived from the same mother cell as the guard cells. Subsidiary cells that are adjacent to guard cells tend to broaden internally and to underlie the guard cells, *Figs. 15* and *17*. Occasionally the internal expansion is so extensive that the subtending parts of the subsidiary cells become concrescent, thus sealing the stoma internally. Where two subsidiary cells are formed lateral to a guard cell, *Fig. 17*, the one adjacent to the guard cell frequently has a narrow exposed outer surface. In certain cases, so little of the cell is exposed that it is easily overlooked in surface view except under high magnification.

Most leaves of *Illicium* have comparatively thick cuticles within which a conspicuous vestibule or entrance to each stoma is formed, *Fig. 15*. The size and form of this cuticular vestibule fluctuate widely, not only in different collections of *Illicium*, but also in different parts of the same leaf. The outer aperture of the vestibule may be large or small, narrowly or broadly elliptical, or more or less rectangular in surface view, due in part to variations in the form and the extension of the outer rim-like projection

[1] Strips of cuticle with attached epidermal cells were obtained by macerating pieces of leaf in a mixture of equal volumes of 5% chromic and 5% nitric acids at a temperature of 56° C. These were then washed, stained in sudan IV and mounted in glycerine. If the macerating treatment is unduly prolonged, the cuticle is modified and loses its staining capacity in sudan IV.

Sections of leaves were prepared by soaking pieces of the lamina in hot water, then in either warm (45° C.) lactic acid or glycerine for two days. The pieces of leaves were then washed, dehydrated, embedded in paraffin, serially sectioned, bleached in concentrated hydrogen peroxide, stained in Haidenhain's haematoxylin and sudan IV and mounted in glycerine.

of the cuticle, *Fig. 15*. There is also more or less extensive internal cutinization subtending the guard cells. The rim-like projections of these cutinized parts commonly are in contact in closed stomata, whereas the walls of the guard cells are not.

In contrast to the tough, leathery, entire leaves of *Illicium*, those of *Schisandra* and *Kadsura* are softer, thinner and commonly provided with more or less numerous serrations. The lateral walls of the epidermal cells may be conspicuously pitted and undulating, but these characters are less pronounced and constant than they are in most species of *Illicium*. Although the cuticle is in general much thinner, it frequently exhibits a more or less conspicuous ribbing which closely resembles that which occurs so conspicuously in *Illicium*. There is a similar radial pattern in the rosettes of cells that surround the secretory cells of the lower epidermis. Furthermore, there are at times similar, but less massive, intrusions of cutin between the ends of the guard cells, *Figs. 18* and *19*. In such cases, there usually are no intrusions of cutin between the ends of the guard cells and adjacent epidermal cells, such as occur so characteristically in the stomatal apparatus of *Illicium*, *Fig. 17*.

The stomata are relatively large, the outline of the paired guard cells fluctuating between narrowly and broadly elliptical and having as in *Illicium* a major axis of from 30 to 70 microns. The subsidiary cells of the stomatal apparatus fluctuate widely in size, form, number and arrangement even within the limits of a single leaf. At one extreme are stomata that have subsidiary cells oriented parallel to the guard cells, as in *Illicium*, *Fig. 17*. At the other extreme of structural variability are guard cells that are subtended by parts of ordinary epidermal cells of diversified form. Numerous transitions between these structural extremes are of common occurrence, *Figs. 18* and *19*. Whether all or certain of the subsidiary cells are derived from the same primordial cell as the guard cells can be determined only by detailed ontogenetic and cytological investigations.

LEAF: VASCULARIZATION

The leaves of *Illicium* are characterized by having a simple, arc-shaped strand of vascular tissues that extends throughout the petiole and the mid-rib of the lamina, *Figs. 1–3*. On the contrary, the leaves of *Schisandra* and *Kadsura* usually have three discrete strands of vascular tissues in the petiole, *Fig. 5*, and the basal part of the lamina. The three separate bundles are replaced, however, by a single arc with involute margins in the central and apical parts of the lamina, *Fig. 6*. Occasionally aberrations occur in this typical pattern of vascularization. In certain cases, the three strands of primary vascular tissue may be bridged by cambial activity. Conversely, division may occur at times, giving rise to more than three strands in the petiole.

LEAF: IDIOBLASTS

Three types of idioblasts, viz. "resin" cells, "mucilage" cells and ramified sclereids, may be present in the leaf, as in the stem, of *Illicium*.

No sclereids are present in the lamina of 30 of the 73 collections of this genus examined by us. In 22 cases, they are diffusely distributed throughout the mesophyll, whereas in 21 of the collections they are confined to tissue in close proximity to the mid-rib. Sclereids occurring in the more spongy parts of the mesophyll tend to be profusely ramified and of highly diversified forms. The lumen may be relatively large and the branches conspicuously tapered, *Fig. 20*, or the lumen may be vestigial and the branches nearly cylindrical with blunt apexes, *Fig. 21*. Sclereids in close proximity to the mid-vein and the vascular tissue of the petiole frequently tend to be massive, to have rectangular outlines in sectional views, and to be provided with contorted branches or with broad irregular lobes, *Fig. 22*. The foliar sclereids of *Illicium* differ from those of *Trochodendron*, see Foster (6), in their smaller size, their less extensive branching and in having smooth, rather than spiculate, outer surfaces.

It should be noted in these connections that the mid-vein and the larger lateral veins usually have a coating of slender, thick-walled fibres, comparable to the "pericyclic" fibres of the stem. Such fibres do not occur, however, about the terminal veinlets which are entirely devoid of sclerenchymatous elements, except in one collection of *I. majus* Hook.f. and Thomson, *Lau 28772*. "Pericyclic" fibres may be present or absent in the petiole.

The foliar "ethereal oil" or "resin" cells of *Illicium* fluctuate considerably in size and abundance. They tend to occur in the spongy mesophyll and the lower epidermis, and to be infrequent, if not invariably absent, in palisade tissue and the upper epidermis. Although they usually are spherical or ovoid in form, they may at times become somewhat lobate in tissue having large intercellular lacunae. Those that originate in the lower epidermis expand inwardly among the subepidermal cells of the leaf. As previously stated, their exposed outer part forms the center of a characteristic rosette of radially oriented epidermal cells, *Fig. 11*.

The size, form and distribution of "mucilage" cells should be studied in freshly collected leaves from living plants, dried leaves from herbarium specimens being unfavorable material for this purpose. In many cases, these cells appear to be confined to the palisade tissue, as observed by Blenk (3) in three species of *Illicium*.

The foliar "ethereal oil" cells of *Schisandra* and *Kadsura* resemble those of *Illicium* in general size, form and distribution, those of the lower epidermis forming the center of similar rosettes of radially oriented epidermal cells. The vascular strands of the petiole and the veins of the lamina differ, however, from those of *Illicium* in having conspicuous and more or less extensively dilated "mucilage" cells of elongated form in the primary phloem (darkly stained cells in *Figs. 5* and *6*). The leaves of *Schisandra* and *Kadsura* also differ markedly from those of *Illicium* in the character and the distribution of sclerenchymatous elements. Typical pitted, symmetrically thickened and profusely ramified sclereids do not occur in the former genus. As in the case of the stem, the sclerenchymatous elements

of the leaf are of an unpitted, asymmetrically thickened and crystal-bearing type. They fluctuate widely in size, form and distribution, *Figs. 24–29*.

In the sections *Pleiostema*, *Maximowiczia* and *Euschisandra* of *Schisandra* and in the section *Cosbaea* and part of the section *Sarcocarpon* of *Kadsura*[2] crystal-bearing sclerenchyma is absent in the lamina and is confined to the basal part of the petiole. In these plants, such cells are usually absent in the pith of the internodal parts of the stems. On the contrary, in the section *Sphaerostema* of *Schisandra* and in the section *Eukadsura* and part of the section *Sarcocarpon* of *Kadsura*, crystal-bearing sclerenchyma occurs, not only in the petiole, but also in the lamina of the leaf. In most cases, the more or less elongated crystal-bearing elements are scattered along the vascular bundles, veins and veinlets, with their long axis oriented parallel to that of the vascular elements. There are, however, several species in the section *Sarcocarpon* of *Kadsura* which exhibit conspicuous aberrations. In *K. marmorata* (E. G. and A. Henderson) A. C. Sm., *Elmer 11718*, *K. lanceolata* King, *M. R. Henderson 11562*, *K. borneensis* A. C. Sm., *J.* and *M. S. Clemens 31889*, and *K. Clemensiae* A. C. Sm., *J.* and *M. S. Clemens 22115* (type), the crystal-bearing elements either are oriented at right angles to the veins or their elongated ends protrude freely into the mesophyll. In *K. marmorata*, some of these sclerenchymatous cells occur independently in the mesophyll and are not related in development to the veins.

The form and the distribution of ordinary pitted fibers are less stereotyped in leaves of *Schisandra* and *Kadsura* than they are in the foliar organs of *Illicium*. The veins and the terminal veinlets may be heavily jacketed by such elements or they may be devoid of them. Not infrequently short fibrous elements are scattered along the veins much as are the elongated crystal-bearing cells. Particularly in the section *Sarcocarpon* of *Kadsura*, there are transitions from elongated fibrous elements to short, broad, irregularly shaped, pitted cells that jacket the terminal veinlets.

DISCUSSION

Illicium obviously is a genus that exhibits a number of relatively stable structural characters in its vegetative organs. Particularly significant in this connection are the uniformity of its unilacunar nodal anatomy, the characteristic vascularization pattern of its leaf, the pseudo-siphonostelic rather than typically eustelic-appearing arrangement of its primary vascular tissues, the specific combinations of primitive and specialized anatomical features of its secondary xylem and phloem, and the curious intercellular intrusions of the cuticle in its stomatal apparatus.

In contrast to *Illicium*, *Schisandra* and *Kadsura* exhibit a combination of relatively stable and highly variable anatomical characters. On the one hand, there is considerable uniformity in the nodal anatomy, the vascularization pattern of the leaf, the presence of conspicuously dilated

[2] For lists of the species included in these sections see Smith (9).

"mucilage" cells in the primary phloem, and the occurrence of curious, asymmetrically thickened, crystal-bearing elements, particularly in the secondary phloem. On the other hand, there is a wide range of variability in the structure of the stomata and especially in the vascular tissues of the stem. The xylem fluctuates — even within the limits of a single plant — from a relatively primitive type to extremes of structural specialization.

What conclusions may be deduced from such anatomical data regarding the affinities of the three genera? How should the various anatomical criteria be weighed in so doing? What actually are the merits of including these genera within the Magnoliaceae? Significant answers to these questions must be based upon a broad knowledge of the behavior of anatomical characters in a wide range of dicotyledonous families. Due allowances must be made for commonly occurring structural similarities due to parallel or convergent evolution, and for differences due to excessively divergent trends of morphological specialization in plants of certain habits of growth, e.g., vines.

During the last 30 years, extensive investigations of the vascular tissues in all of the principal orders and families of the dicotyledons have revealed and clarified the salient trends of phylogenetic specialization that occur in these tissues. Thus, it now is possible in many cases to assess the evolutionary significance of specific combinations of structural characters in the vascular tissues. Unfortunately, there is as yet no comparable body of reliable information regarding the epidermis, cortex and pith of the stem and the epidermis and mesophyll of the leaf in dicotyledons. Therefore, there is no conclusive evidence available at present for determining whether the ancestral dicotyledons actually possessed certain specific types of stomata, secretory cells, sclerenchyma, etc.

The vegetative organs of *Schisandra* and *Kadsura* are so similar and exhibit such similar ranges of structural variability that the two genera can be separated at present only upon the basis of differences in their reproductive parts. The Schisandraceae differ, however, from other woody plants of ranalian affinities in the occurrence within them of a peculiar and distinctive type of crystal-bearing sclerenchyma and in peculiarities of structural specialization in the xylem of the stem. How significant are such anatomical differences? Do they preclude relatively close genetic relationship, for example between *Illicium* and the Schisandraceae? It should be emphasized in this connection that differences of comparable magnitude occur not infrequently in families having both arboreal and scandent representatives. In fact, the structural differences in the xylem are no greater than those that differentiate arboreal from scandent species of such genera as *Bauhinia* and *Gnetum*. Therefore, in comparing *Illicium* and the Schisandraceae, it is essential to allow for the acceleration of structural specialization in plants, viz. *Schisandra* and *Kadsura*, that have acquired a climbing habit of growth.

Fortunately, the first-formed secondary xylem of vines and lianas frequently affords valuable clues regarding the general level of structural

specialization in the trees or shrubs from which such scandent plants were derived. Thus, the inner wood in the less modified parts of the stems of *Schisandra* and *Kadsura* clearly indicates that these genera were derived from plants having a typically eustelic structure and a relatively primitive type of secondary xylem in which the multiseriate rays extended outward from the interfascicular parts of the eustele. Although the first-formed secondary xylem in the less modified parts of *Schisandra* and *Kadsura* resembles the later-formed wood of *Illicium*, it is evident that these scandent genera cannot have been derived directly from *Illicium*. This is due to the fact that modification of the eustele and reduction of the multiseriate rays is more advanced in *Illicium* than in the scandent genera.

However, the available anatomical evidence does not negate the derivation of the three genera from a common ancestor. Such a possibility of relatively close genetic relationship between *Illicium* and the Schisandraceae is strengthened by similarities in the cuticles, the stomata, the "ethereal oil" cells and particularly the "mucilage" cells of these plants. "Ethereal oil" cells and stomata, having subsidiary cells oriented parallel to the guard cells, are of common occurrence in various families of the more woody ranalian complex, and taken by themselves are not indicative necessarily of specific, rather than of generalized, ranalian affinities. On the contrary, the peculiar elongated or cambiform "mucilage" cells, which occur so characteristically in the phloem of *Illicium* and the Schisandraceae, have not been encountered by us in other woody representatives of the ranalian complex. Furthermore, the unilacunar nodes of *Illicium*, *Schisandra* and *Kadsura* — in contrast to the prevailingly trilacunar or multilacunar nodes of the Winteraceae, Degeneriaceae, Himantandraceae, Magnoliaceae, Trochodendraceae, etc. — are likewise indicative of possibly close genetic relationship.

Detailed studies of the comparative anatomy of the vegetative organs of woody ranalian families reveal no cogent evidence for including either *Illicium* or the Schisandraceae in the Magnoliaceae. When constituted of the ten genera — *Liriodendron*, *Magnolia*, *Manglietia*, *Michelia*, *Talauma*, *Kmeria*, *Aromadendron*, *Alcimandra*, *Pachylarnax* and *Elmerrillia* — as suggested by Dandy (4), the Magnoliaceae are a very natural grouping of plants which exhibit a relatively high degree of structural uniformity in all of their vegetative and reproductive parts. The inclusion of *Drimys* and its allies, *Illicium*, *Schisandra*, and *Kadsura* introduces structurally incongruous elements which are only remotely related to the Magnoliaceae (*sensu stricto*). Thus, the wide evolutionary gap between the vesselless xylem of the Winteraceae and that of the vessel-bearing Magnoliaceae precludes close relationship between the two groups of plants, as does the unusually high degree of structural specialization and complexity in the nodes and leaves of the Magnoliaceae. Similarly, widely divergent and entirely different trends of structural specialization in the xylem, phloem, nodes and leaves of *Illicium*, *Schisandra*, and *Kadsura* serve as a serious obstacle to the inclusion of these genera in the Magnoliaceae. That such

conclusions are strengthened by detailed investigations of the reproductive parts of these plants will be shown in a subsequent paper. The significance of recent publications of Lemesle and Ozenda will be discussed in this second contribution.

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EXPLANATION OF PLATES

PLATE I

FIG. 1. *Illicium anisatum* L. *H. U. 15749.* Transverse section of the unilacunar node. × 10. FIG. 2. *I. anisatum. H. U. 17326.* Transverse section of the petiole showing single broad arc of vascular tissues. × 18. FIG. 3. *I. anisatum. H. U. 17326.* Transverse section of the leaf, showing broad arc of vascular tissues. × 18. FIG. 4. *Schisandra chinense* (Turcz.) Baill. *H. U. 17371.* Transverse section of the unilacunar node, showing three separate vascular strands at the base of the leaf. × 13. FIG. 5. *S. chinense. H. U. 17370.* Transverse section of the petiole showing three separate strands of vascular tissues. × 18. FIG. 6. *S. chinense. H. U. 17370.* Transverse section of the leaf showing single arc of vascular tissues. × 18.

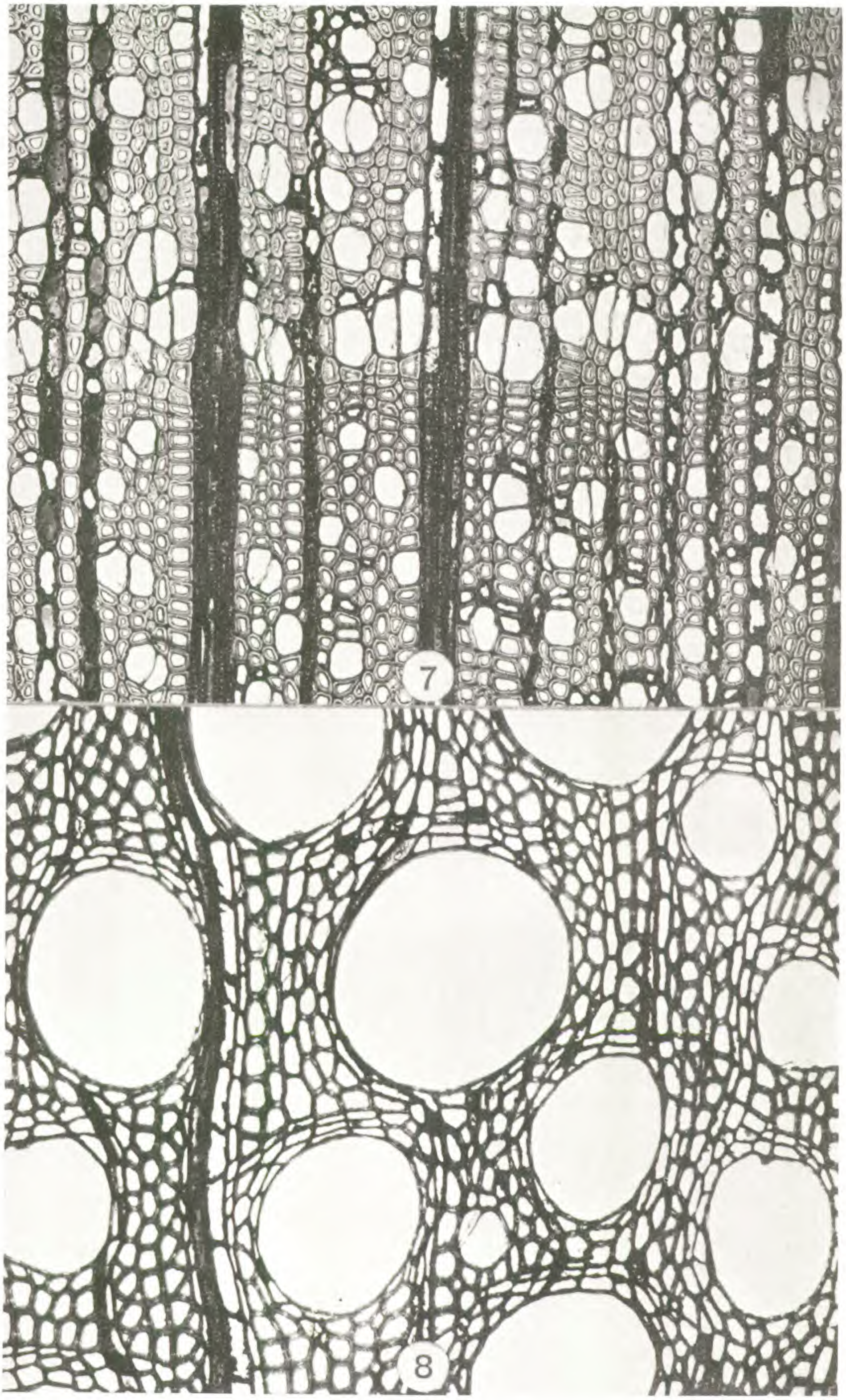
PLATE II

FIG. 7. *Illicium. Y. U. 24057.* Transverse section of the wood from the outer part of an old stem, showing heterogeneous rays and distribution of vessels and wood parenchyma. × 120. FIG. 8. *Kadsura scandens* (Bl.) Bl. *H. U. 17341.* Transverse section of the wood, showing huge vessels, large thin-walled tracheids and abaxial paratracheal wood parenchyma. × 120.

PLATE III

FIG. 9. *Illicium. H. U. 15763.* Tangential longitudinal section of wood close to the primary body showing uniseriate rays only. × 120. FIG. 10. *Illicium. H. U. 11175.* Tangential longitudinal section of wood from the outer part of an older stem, showing both uniseriate and triseriate rays. × 120. FIG. 11. *I. Masa-Ogatai* (Makino) A. C. Smith. *Kanehira 3386.* Lower surface of the leaf showing stomata, secretory cell, ribbed cuticle and undulating contour of epidermal cells. × 250.

MORPHOLOGY OF ILLICIUM, SCHISANDRA AND KADSURA



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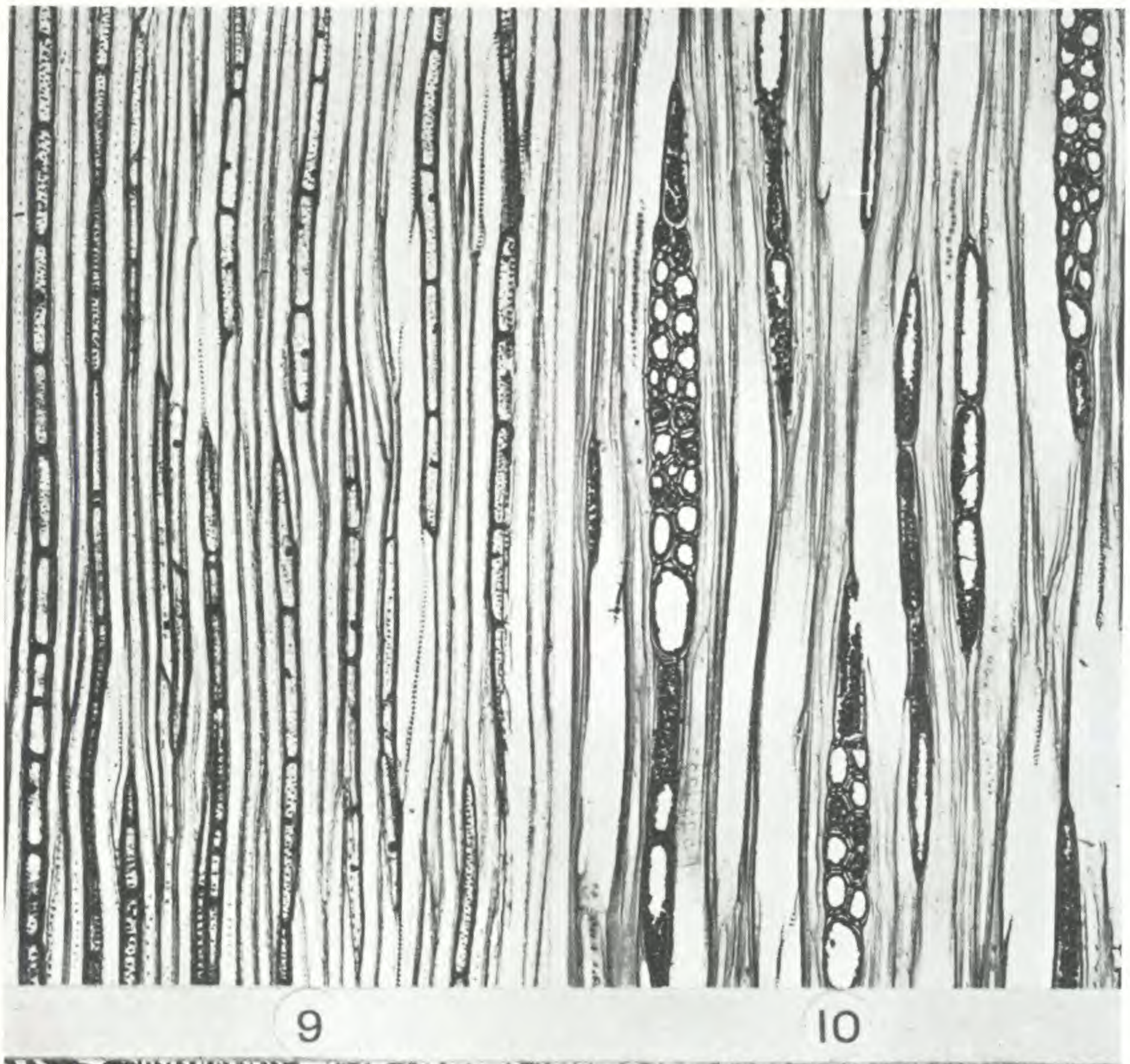

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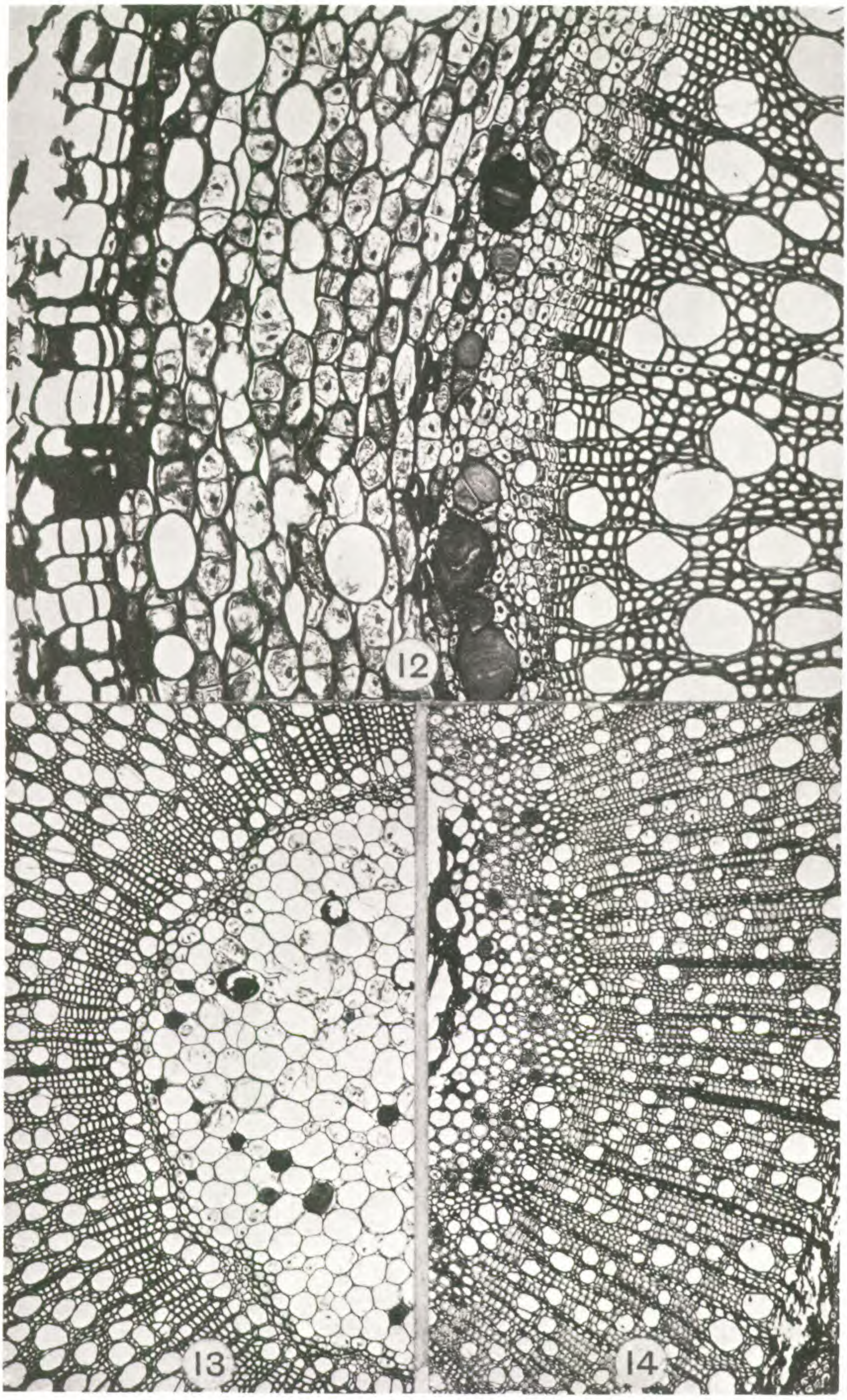

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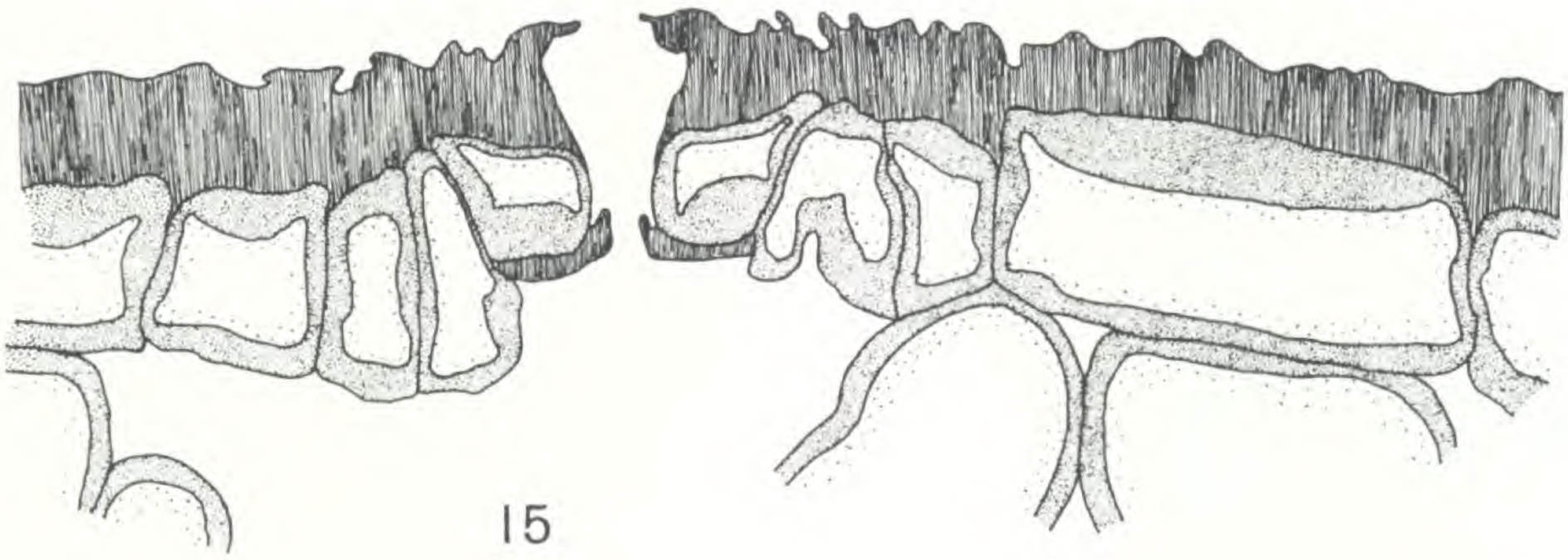

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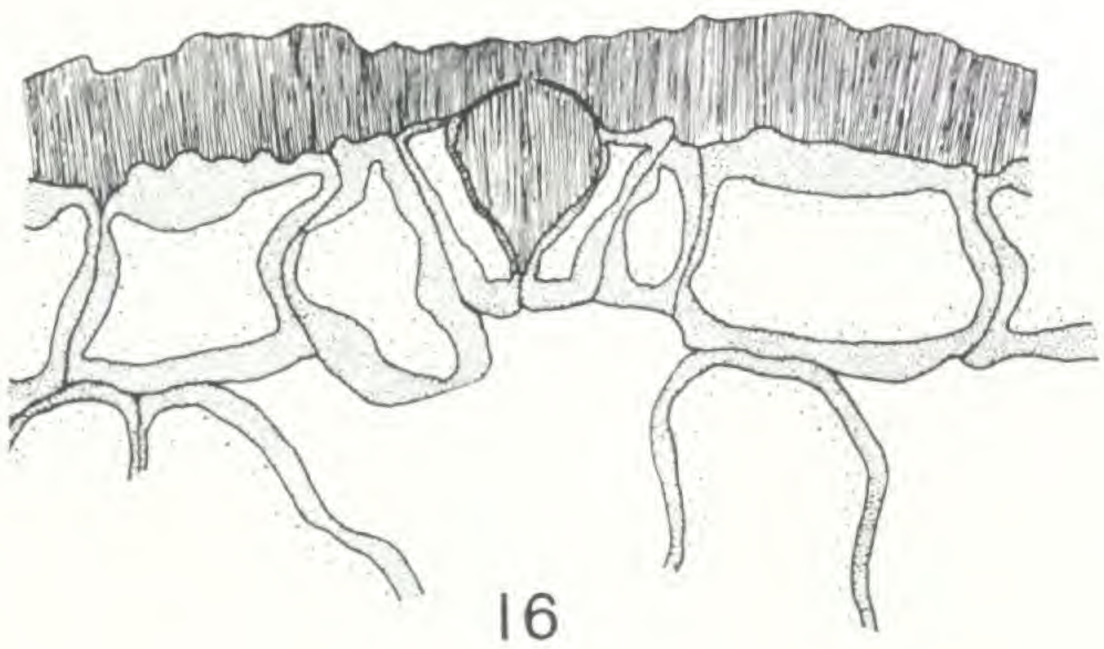

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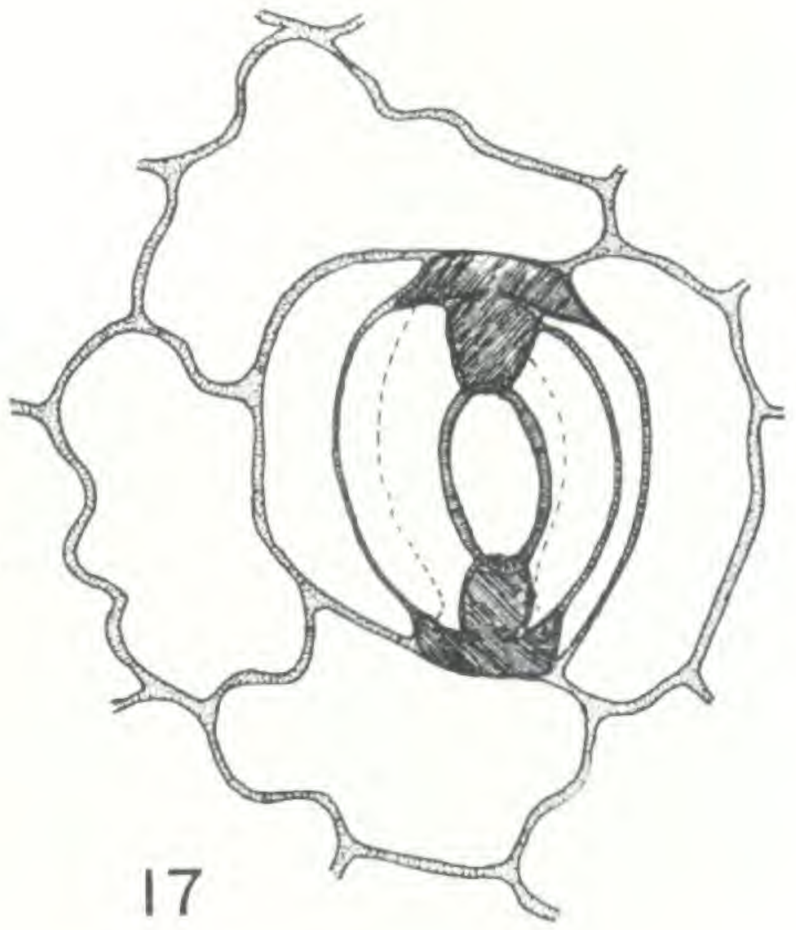

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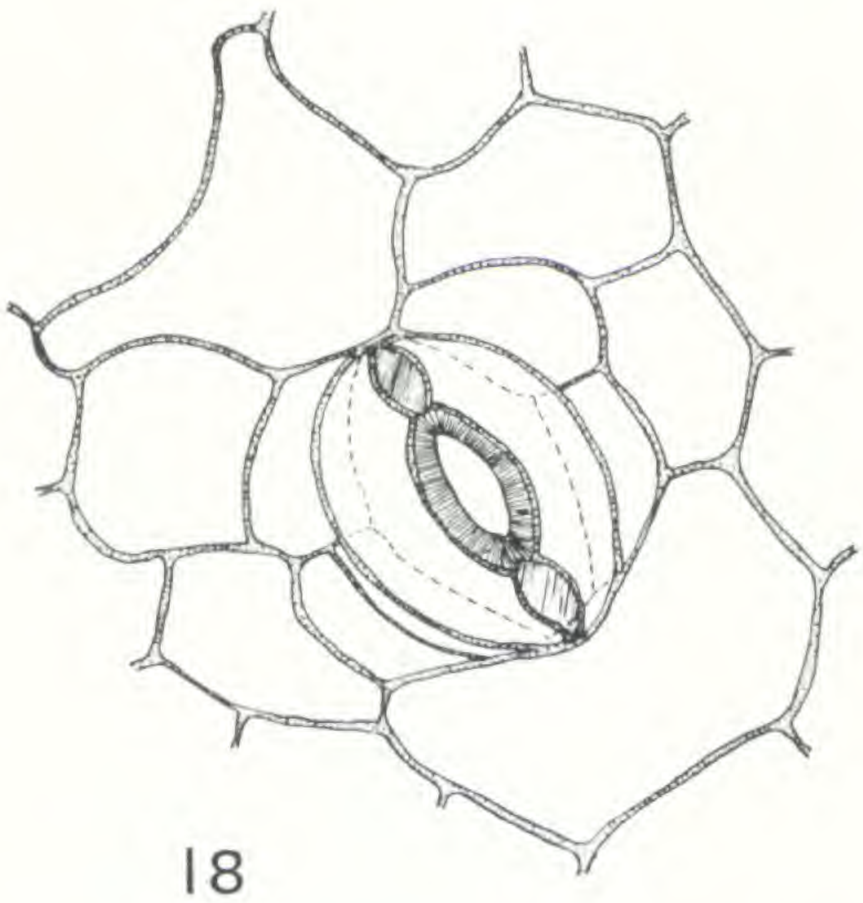

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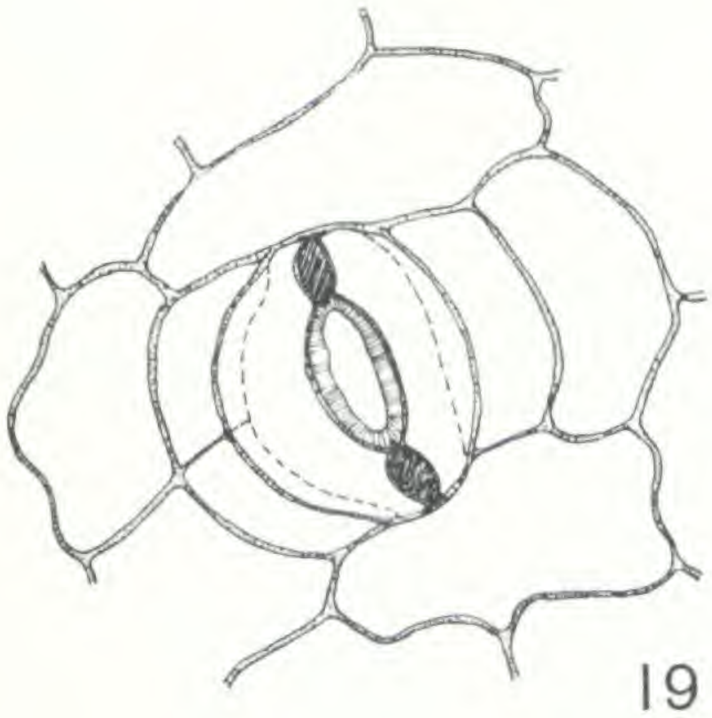

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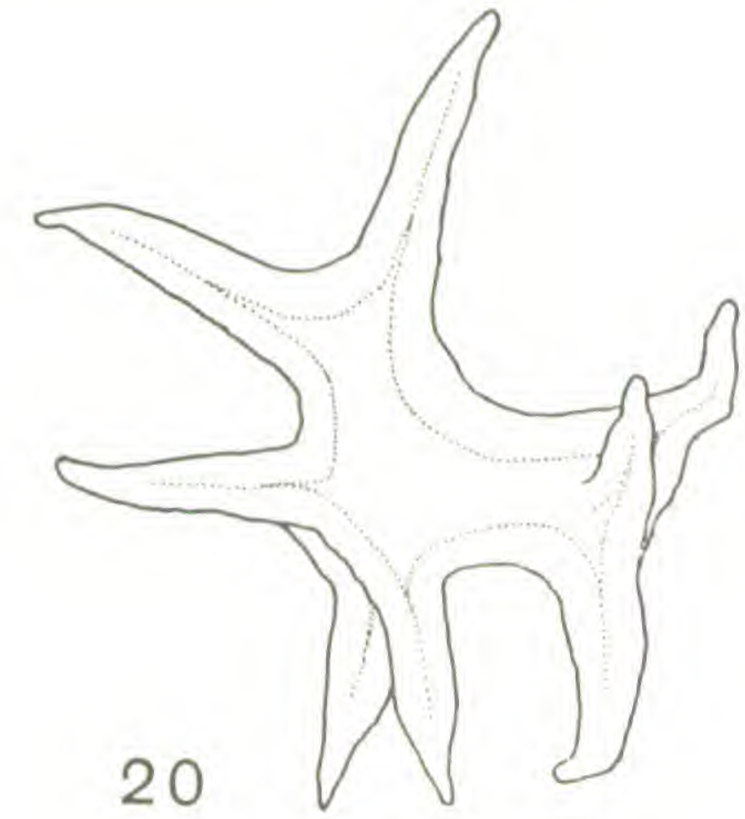

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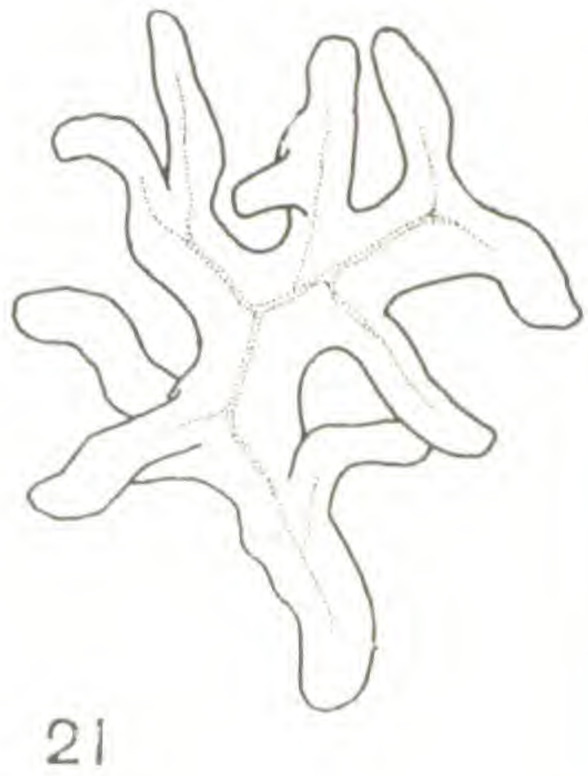

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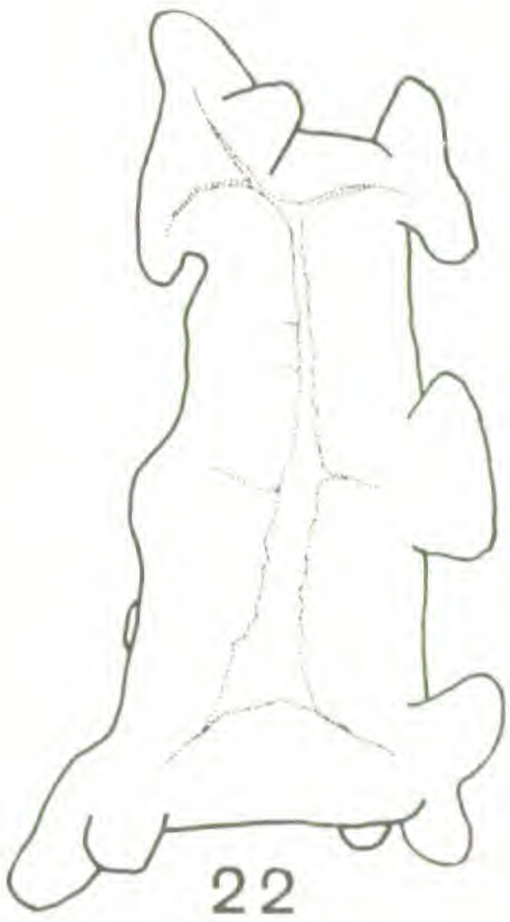

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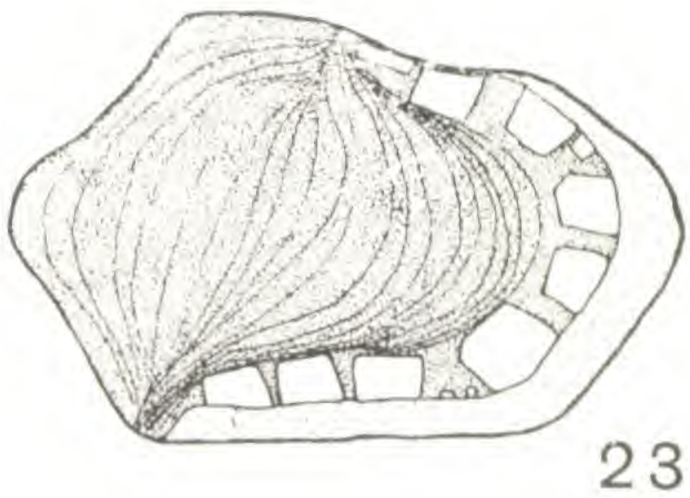

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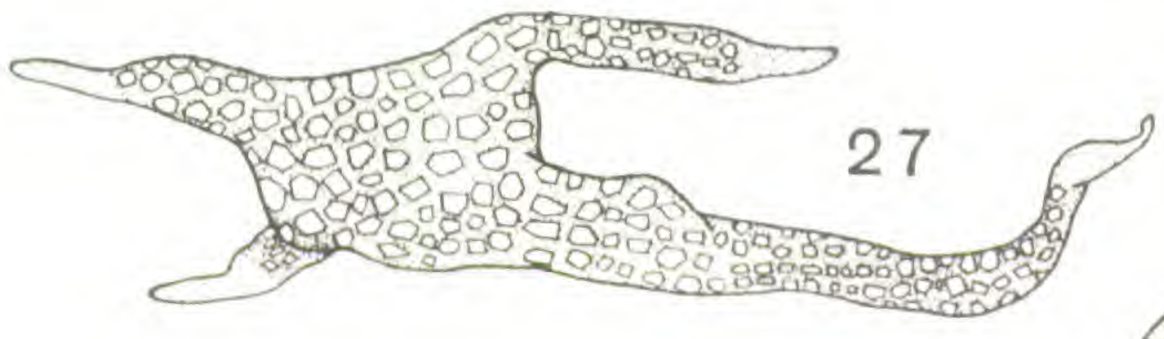

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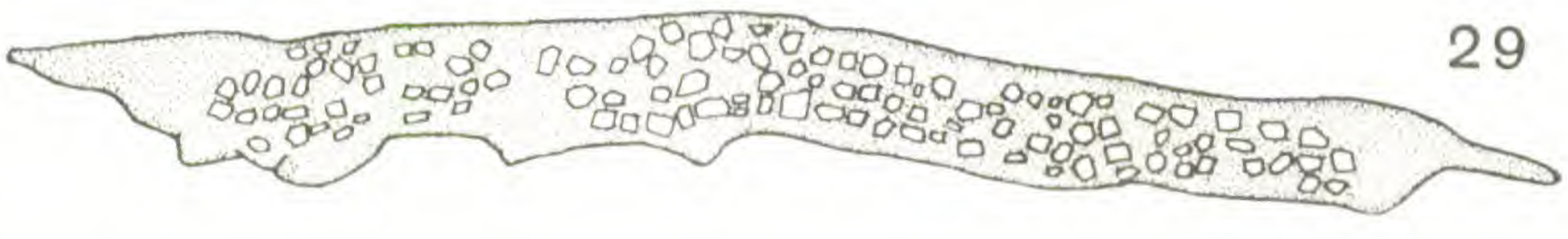

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PLATE IV

FIG. 12. *Schisandra chinense* (Turcz.) Baill. *H. U. 17370.* Transverse section of the outer part of a young stem, showing "mucilage cells" with darkly stained contents in outer phloem and large oval "resin cells" in the cortex. × 120. FIG. 13. *The same.* Central part of the stem, showing continuous ring of metaxylem vessels succeeded by a narrow zone of vesselless wood. × 50. FIG. 14. *Kadsura coccinea* (Lem.) A. C. Sm. *Tso 20393.* Transverse section of part of a young stem, showing discrete strands of primary xylem with multiseriate rays extending outward from the parenchymatous interfascicular lacunae. × 50.

PLATE V

FIG. 15. *Illicium philippinense* Merr. *Wilson 10182.* Transverse section through center of a stomatal apparatus. × 760. FIG. 16. *The same.* Transverse section of the stomatal apparatus cut through the cuticular intrusion. × 760. FIG. 17. *The same.* Surface view of a stomatal apparatus. × 470. FIG. 18. *Kadsura coccinea* (Lem.) A. C. Sm. *Tso 20740.* Surface view of stomatal apparatus. × 300. FIG. 19. *The same.* Surface view of stomatal apparatus. × 300.

PLATE VI

FIG. 20. *Illicium leiophyllum.* A. C. Sm. *W. J. Tutcher (Hongk. Herb.) 6* (TYPE). A foliar sclereid with large lumen and tapered branches. × 250. FIG. 21. *I. Simonsii* Maxim. *Ten 160.* A foliar sclereid with occluded lumen and blunt branches. × 250. FIG. 22. *I. Stapfii* Merr. *J. & M. S. Clemens 35060.* A massive rectangular sclereid. × 250. FIG. 23. *Schisandra elongata* (Bl.) Baill. *H. U. 15775.* Crystal-bearing sclerenchymatous cell in sectional view. × 640. FIG. 24. *Schisandra plena* A. C. Sm. *Henry 10854* (TYPE). Crystal-bearing sclerenchymatous element. × 300. FIG. 25. *The same.* Crystal-bearing sclerenchymatous element. × 300. FIG. 26. *Schisandra propinqua* (Wall.) Baill. var. *intermedia* A. C. Sm. *Hooker & Thomson s.n.* Crystal-bearing sclerenchymatous element. × 210. FIG. 27. *Kadsura borneensis* A. C. Sm. *J. & M. S. Clemens 31889.* Crystal-bearing sclerenchymatous element. × 210. FIG. 28. *The same.* Crystal-bearing sclerenchymatous element. × 210. FIG. 29. *Schisandra propinqua* (Wall.) Baill. var. *intermedia* A. C. Sm. Crystal-bearing sclerenchymatous element. × 300.

INSTITUTE FOR RESEARCH
IN GENERAL PLANT MORPHOLOGY
HARVARD UNIVERSITY.

THE CYPERACEAE COLLECTED IN NEW GUINEA BY L. J. BRASS, III*

S. T. BLAKE

With one text-figure

THIS PAPER deals exclusively with the genera of the Rhynchosporoideae. A monograph of this tribe was commenced by G. Kükenthal prior to, and was continued during the war, but it was only after this paper had been almost completed that most of his published work became available. For the most part my treatment agreed well with that of Kükenthal; when it was found to differ, the group concerned was re-examined, but occasionally it was found not possible to reconcile the two points of view. These differences of opinion are discussed under the species concerned.

Schoenus Linnaeus

Schoenus falcatus R.Br. Prodr. 232. 1810; Kükenth. in Engl. Bot. Jahrb. 69: 259. 1938, in Fedde, Repert. 44: 24. 1938, 48: 247. 1940, in Bull. Jard. Bot. Buitenz. III, 16: 304. 1940.

PAPUA: Western Division: Penzara, between Morehead and Wassi Kussa Rivers, *Brass 8469*, Dec. 1936, savannah-forest. Central Division: Hisiu, *Carr 11448*, Feb. 1935, sea-level, open savannah land (about 42 in. tall).

SOLOMON ISLANDS: Olevuga Island: N'Gela, *Brass 3485*, Jan. 1933, stiff sedge on grasslands.

New for the Solomon Islands. Known previously from northern Australia, New Guinea and other parts of Malaysia, and Tonkin.

Schoenus punctatus R.Br. Prodr. 232. 1810; Kükenth. in Fedde, Repert. 48: 247. 1940.

PAPUA: Western Division: Tarara, Wassi Kussa R., *Brass 8388*, Dec. 1936, savannah-forest, characteristic cover on gray soil flats.

Brass's collection was cited by Kükenthal, l.c. The species is elsewhere known from northern Australia, Marianne Islands and Siam.

Schoenus sparteus R.Br. Prodr. 231. 1810; Kükenth. in Fedde, Repert. 44: 28. 1938, 48: 247. 1940.

PAPUA: Western Division: Tarara, Wassi Kussa R., *Brass 8534*, Dec. 1936, in poorly drained savannah forest; Tarara, Wassi Kussa R., *Brass 8578*, Dec. 1936, savannah forest, very abundant on wet flats; Tarara, Wassi Kussa R., *Brass 8726*, Jan. 1937, open savannah-forest, covering poorly drained flats (young growths after burning); Mai Kussa R., *W. MacGregor* in 1890 (herb. Melbourne).

Brass's three collections were cited by Kükenthal, 1940, l.c. The species appears to be confined to northern and north-eastern Australia and New Guinea.

* Botanical Results of the Richard Archbold Expeditions. See Jour. Arnold Arb. 28: 207–229. 1947.

Schoenus laevinux (Kükenth.) Ohwi in Jour. Japan. Bot. 18: 136. 1942, in Bot. Mag. Tokyo 56: 206. 1942.

Schoenus melanostachyus R.Br. var. *laevinux* Kükenth. in Engl. Bot. Jahrb. 59: 52. 1924.

Schoenus tendo (Hook.f.) Hook.f. var. *laevinux* (Kükenth.) Kükenth. in Fedde, Repert. 44: 30. 1938, in Engl. Bot. Jahrb. 69: 259. 1938, in Fedde, Repert. 48: 247. 1940.

NETHERLANDS NEW GUINEA: Hollandia and vicinity, *Brass 8905*, June-July, 1938, alt. 30 m., several clumps on a cliff face in rain-forest (stems pendent); 18 km. SW. of Bernhard Camp, Idenburg R., *Brass 12474*, Feb. 1939, alt. 2150 m., associated with ferns and *Lycopodium* on open rock slide.

The species is apparently confined to New Guinea, although externally it is very similar to *S. tendo* var. *triander* Kükenth. from New Caledonia, of which I have seen flowering material only. It resembles *S. melanostachyus* in habit, but has a smooth (not rugose) glassy, white (not ferrugineous), obovoid rather than ovoid nut, and it differs from *S. tendo* in the symmetrical glassy nut, absence of hypogynous bristles, non-sulcate culms and more copious panicles.

Schoenus calostachyus (R.Br.) Poir. Encycl. Suppl. 2: 251. 1811; F.Muell. Pap. Pl. 2: 69. 1890; Valck. Suring. in Nova Guin. Bot. 8: 707. 1912; Kükenth. in Fedde, Repert. 44: 73. 1938, 48: 248. 1940; Ohwi in Bot. Mag. Tokyo 56: 207. 1942.

Chaetospora calostachya R.Br. Prodr. 233. 1810.

Cyclocampe waigiouensis Steud. Synops. Cyper. 156. 1855.

PAPUA: Western Division: Dagwa, Oriomo R., *Brass 5912*, Feb.-March 1934, alt. 40 m., common on rather damp open grass slopes; Tarara, Wassi Kussa R., *Brass 8564*, Dec. 1936, savannah-forests, common on gray soils; Tarara, Wassi Kussa R., *Brass 8535*, Dec. 1936, poorly drained savannah-forests; Mai Kussa R., *W. MacGregor* in 1890 (herb. Melbourne).

Brass's collections were cited by Kükenthal, 1940 l.c. The species extends from New South Wales to Malaya.

Schoenus curvulus F.Muell. in Trans. Roy. Soc. Vict. n.s. 1(2): 36. 1889; C. B. Clarke in Kew Bull. 1899: 114. 1899; Valck. Suring. in Nova Guin. Bot. 8: 707. 1912; Kükenth. in Fedde, Repert. 44: 76. 1938, in Engl. Bot. Jahrb. 69: 260. 1938, in Fedde, Repert. 48: 248. 1940, in Bull. Jard. Bot. Buitenz. III, 16: 305. 1940.

NETHERLANDS NEW GUINEA: Mt. Wilhelmina, 7 km. NE. of top, *Brass & Meyer-Drees 9973*, Sept. 1938, alt. 3560 m., common on wet grass slopes.

PAPUA: Central Division: Mt. Albert Edward, *Brass 4447*, May-July 1933, alt. 3680 m., massed under rocks on marshy bank of a grassland stream; Mt. Tafa, *Brass 5006*, May-Sept. 1933, alt. 2400 m., in small erect tufts on dry crumbling soil of an exposed ridge point; Murray Pass, Wharton Range, *Brass 4672*, June-Sept. 1933, alt. 2840 m., common on open grasslands, most frequently found under shelter of tree-ferns; Mt. Victoria, *W. MacGregor* in 1889 (herb. Melbourne); near summit of Owen Stanley Ranges, *W. MacGregor* in 1889 (type in herbb. Melbourne, Brisbane); without definite locality, *W. MacGregor* in 1894 (herbb. Melbourne, Brisbane).

Confined to New Guinea. *Brass 4447* was cited by Kükenthal in Fedde, Repert. 48: 248. 1940.

In his original description, F. Mueller lays considerable stress on the curved or twisted stems and leaves, but the appearance of the specimens suggest that the twisting is due to the method of collecting or their preparation. In common with other specimens collected by MacGregor

(cited in this and earlier papers) they give the impression of having been hastily pulled and crammed into a pocket.

The species was described by Kükenthal in his revision of the genus in Fedde, Repert. 44: 76. 1938 as having 1–2-noded culms, leaves with circinate tips and spikelets 6–8 mm. long. The leaves of the type-collection as well as of Brass's specimens have straight tips, the spikelets are 6–7 mm. long or sometimes as short as 5 mm. on Brass's specimens. Owing to the unusually long leaf-sheaths, the number of nodes is not always easy to ascertain without stripping off the leaves, but certainly sometimes reaches 4. Sometimes the whole of the culm beneath the inflorescence is concealed by the sheaths.

Schoenus curvulus is rather closely allied to some forms of *S. apogon* R. & S., differing chiefly in the looser inflorescence with fewer larger spikelets, longer and relatively narrower elliptic-oblong nuts more prominently apiculate and nearly smooth, and in the hypogynous bristles longer than the nut. *Schoenus erythrosiphon* Ohwi in Bot. Mag. Tokyo 56: 205. 1942, appears to be very similar from the description, differing chiefly in the smaller spikelets 4–5 mm. long, and shorter anthers with the connective only shortly produced.

Schoenus setiformis sp. nov. (sect. *Helothrix* (Nees) Kükenth.). FIG. 1.

Herba perennis, rhizomate abbreviato. Culmi plurimi, dense caespitosi, simplices, tenuiter setacei, rigidi, circiter 5–25 cm. alti, 0.25–0.4 mm. crassi, teretes, striati ceterum laeves, glabri, sub inflorescentia 1–2-nodes vel enodes, foliati. Folia basilaria et caulina setacea, culmo breviora, circiter 0.25–0.4 mm. lata, supra canaliculata, subtus convexa leviter striata, apicem versus scaberula; vaginae 1–2 cm. longae, purpureae, ore truncato imberbes, basilaribus apertae, caulinae clausae. Panicula plerumque capitata, 7–12 mm. longa lataque, 7–12-spiculata, e fasciculis 2 valde approximatis composita, interdum fasciculo tertio distante addito; rami in quoque fasciculo 1–7, indivisi, usque ad 6 mm. longi. Bracteae foliaceae inflorescentiam superantes vel inferiores longe superantes, ore vaginae imberbes. Spiculae breviter pedicellatae, nigricantes vel purpureotinctae, lanceolatae vel oblongo-lanceolatae, 3.3–4.5 mm. longae, 0.9–1.2 mm. latae, 1–3-florae. Glumae 6–7 nigricantes vel atropurpurae, nitidulae, lanceolatae, carina concolore sursum scaberula percursae, marginibus angustissime albo-hyalinis glabrae, inferiores 3–4 vacuae latiores acutiores, superiores anguste obtusae 2.5–3.3 mm. longae. Setae hypogynae 6, ± ferrugineae vel purpurascentes, antrorsim scabrae, nucem superantes. Stamina 3, antherae lineares flavae, connectivum mediocriter (circiter 0.2–0.3 mm.) productum subulatum, circiter 1.3–1.4 mm. longae. Stylus brunneus, 1 mm. longus; stigmata 3, stylo aequilonga. Nux ellipsoidea vel angustius ovoidea, apice vel utrinque acuta, apiculata, prominule tricostulata, lateribus convexa, pallida mox brunnescens, nitida, fere omnino laevis cellulis extimis minimis valde obscuris, 1.1–1.3 mm. longa, 0.5–0.65 mm. lata.

NETHERLANDS NEW GUINEA: Mt. Wilhelmina, 11 km. NE. of top, *Brass & Meyer-Drees 9724*, Sept. 1938, alt. 3400 m., wet grassy western slope; Mt. Wilhelmina, 7 km. NE. of top, *Brass & Meyer-Drees 9998*, Sept. 1938, alt. 3560 m., gray clay of old landslips, plentiful; Lake Habbema, *Brass 9478*, Aug. 1938, alt. 3225 m.,

niches on a precipitous rock face; 9 km. NE. of Lake Habbema, *Brass 10561*, Oct. 1938, alt. 2750 m., few clumps in open stony bed of stream; 9 km. NE. of Lake Habbema, *Brass 10923* (TYPE), Oct. 1938, alt. 2800 m., common on landslip with *Imperata cylindrica*.

This species is distinguished particularly by the very slender but rigid culms and leaves, the few-spikeleted inflorescence which is usually reduced to two approximated fascicles of about 8–10 spikelets in all (though occasionally there is a third fascicle of 1–3 spikelets lower down), and the shining smooth nut with tiny indistinct external cells, stramineous when young but soon becoming brown and overtopped by the more or less ferrugineous or purple hypogynous bristles. It comes under series *Microcarpae* Benth. or sect. *Helothrix* (Nees) Kükenth., and is allied to *S. curvulus* F. Muell., *S. erythrosiphon* Ohwi and *S. apogon* R. & S., but differs from all three in the extremely slender though rigid and straight culms and leaves, coloured hypogynous bristles, and quite smooth more or less brown (not white) nut with very small and obscure external cells. From the first two it differs also in the short leaf-sheaths, scanty capitate inflorescence of few shortly pedicellate mostly smaller spikelets and smaller style, and from *S. curvulus* in the shorter anthers with shorter appendage. From *S. apogon* it also differs in the narrower acute nut overtopped by the bristles, and, except, for reduced states, in the small capitate inflorescence.

Perhaps the plants referred to *S. apogon* by Ridley in Trans. Linn. Soc. II, Bot. 9: 243. 1916, belong here.

Schoenus foliatus (Hook.f.) S. T. Blake in Proc. Roy. Soc. Queensl. 51: 48. Feb., 1940.

Schoenus foliatus (Hook.f.) Kükenth. in Fedde, Repert. 48: 248. Sept. 1940.

Schoenus axillaris (R.Br.) Poir. Encycl. Suppl. 2: 251. 1811, non Lam.

Schoenus subaxillaris Kükenth. in Fedde, Repert. 44: 89. 1938, in Engl. Bot. Jahrb. 69: 260. 1938.

Chaetospora axillaris R.Br. Prodr. 233. 1810.

Helothrix pusilla Nees in Ann. Nat. Hist. sér. I, 6: 45. 1841, non *Schoenus pusillus* Sw.

Scirpus foliatus Hook.f. in London Jour. Bot. 3: 414. 1844.

Helothrix axillaris (R.Br.) Palla in All. Bot. Zeitschr. 8: 68. 1902.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9236*, Aug. 1938, alt. 3225 m., growing with mosses on sunny seepages.

New for Netherlands New Guinea; previously recorded from North-East New Guinea, the more southern parts of Australia, New Zealand and the Chatham Islands.

The combination *Schoenus foliatus* was published independently by Dr. Kükenthal and myself. My paper has priority by slightly over seven months.

Carpha R. Brown

Carpha alpina R.Br. Prodr. 230. 1810; F.Muell. in Trans. Roy. Soc. Vict. n.s. 1(2): 35. 1889; C. B. Clarke in Kew Bull. 1899: 114. 1899; Valck. Suring. in Nova Guin. Bot. 8: 706. 1912; H. Pfeiff. in Fedde, Repert. 29: 178. 1931; Kükenth. in Fedde, Repert. 47: 112. 1939.

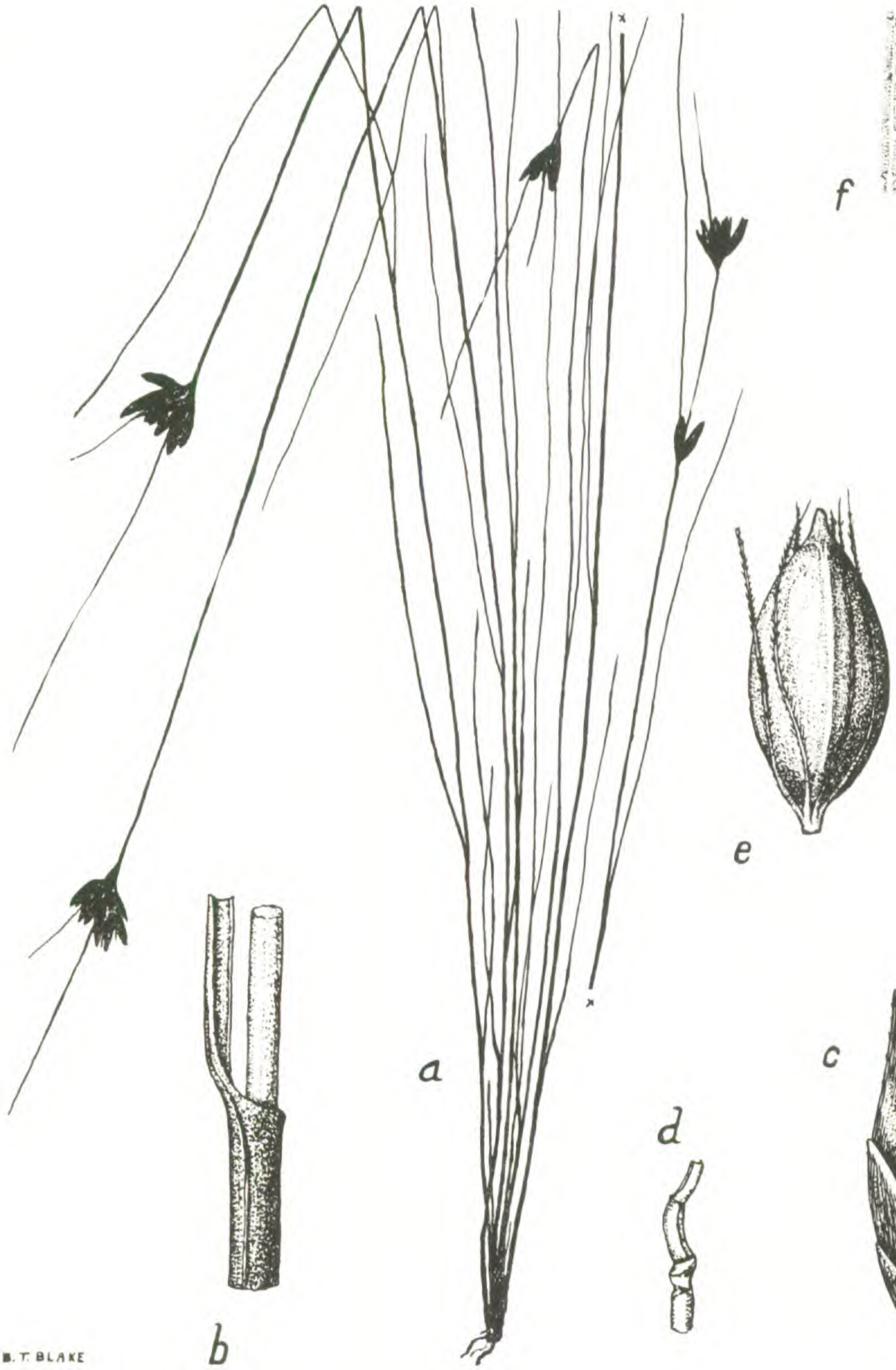

FIG. 1. *Schoenus setiformis* S. T. Blake: *a.* portion of plant, × 1; *b.* portion of culm with apex of cauline leaf-sheath and base of blade, × 10; *c.* spikelet, × 10; *d.* rhachilla of spikelet, glumes and flowers removed, × 10; *e.* nut, with torus and hypogynous bristles, but with filaments removed, × 30; *f.* surface of nut, × 100. From type-specimen.

NETHERLANDS NEW GUINEA: Northern slopes of Mt. Wilhelmina, *Brass & Meyer-Drees 10078*, Sept. 1938, alt. 4160 m., alpine grassland, covering sandy banks of a small stream; Mt. Wilhelmina, 7 km. NE. of top, *Brass & Meyer-Drees 9925*, Sept. 1938, alt. 3650 m., alpine grassland, very abundant in marshy hollows (clumps 20–30 cm. high).

PAPUA: Central Division: Mt. Albert Edward, *Brass 4299*, May-July 1933, alt. 3800 m., very plentiful on alpine seepage slopes (leaves somewhat glaucous); near summit of Owen Stanley Range, *W. MacGregor* in 1889 (herbb. Brisbane, Melbourne); Mt. Knutsford, *W. MacGregor* in 1889 (herb. Melbourne).

Not previously reported from Netherlands New Guinea. The species occurs in south-eastern Australia, Tasmania and New Zealand.

Carpha schoenoides Banks & Sol. ex Hook.f. Fl. Antarct. **2**: 362, *t. 148*. 1847, from Tierra del Fuego is evidently very closely allied, but appears to differ in the fewer solitary spikelets each 2-flowered with the hypogynous bristles plumose to the tips and a serrate-scabrous style-base.

Costularia C. B. Clarke

Costularia Urvilleana (Gaud.) Kükenth. in Fedde, Repert. 46: 28. 1939.

Carpha arundinacea Brongn. in Duperr. Voy. Coquille Bot. 2: 169, *t. 30*. 1829, non (Vahl) Boeck.

Carpha Urvilleana Gaud. ex Nees in Linnaea 10: 300. 1834.

Lophoschoenus Urvilleanus (Gaud.) Stapf in Jour. Linn. Soc. Bot. 42: 180. 1914.

NETHERLANDS NEW GUINEA: Hollandia and vicinity, *Brass 8802*, June-July 1938, alt. 5–30 m., plentiful in rather distant clumps on stony patches of dry open slopes.

New for New Guinea. Previously known from Borneo and the Moluccas.

Oreobolus R. Brown

Oreobolus pumilio R.Br. Prodr. 236. 1810; Kükenth. in Engl. Bot. Jahrb. 70: 464. 1940.

Oreobolus Clemensiae Kükenth. in Fedde, Repert. 48: 69. 1940.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9244*, Aug. 1938, alt. 3225 m., one of the characteristic plants of alpine bog turf, carpet forming or in small rounded clumps.

New for Netherlands New Guinea. Kükenthal in Engl. Bot. Jahrb., l.c., records it for North-East New Guinea, but in the same year based his *O. Clemensiae* Kükenth., l.c., on the same collection (which I have not seen), without any reference to his other paper. *Brass 9244* agrees well with the description of *O. Clemensiae* and, except for the somewhat longer leaves, with Tasmanian specimens of *O. pumilio* R.Br. The breadth of the perianth-segments (hypogynous scales) and the colour of the leaf-sheaths and glumes are variable on the Tasmanian plants, and the spikelets of the New Guinea plants are *not* shorter. It seems likely that Kükenthal has drawn up his description of *O. pumilio* for his revision in Fedde, Repert., l.c., from plants other than Tasmanian. The species, so far as I have seen specimens, is elsewhere known with certainty only from Tasmania and Victoria. The range "Nordaustralien" given by Kükenthal in Engl. Bot. Jahrb., l.c., was due probably to a slip of the pen. The species

has been stated to occur in New Zealand (cf. Kükenthal in Fedde, Repert. 48: 67. 1940), but all the specimens I have seen from that region belong to other species.

Oreobolus ambiguus Kükenth. & van Steenis in Bull. Jard. Bot. Buitenz. III, 14: 47, *fig. 1.* 1936; Kükenth. in Engl. Bot. Jahrb. 70: 463. 1940, in Fedde, Repert. 48: 72. 1940.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9579*, Aug. 1938, alt. 3225 m., one of the characteristic plants of alpine bog turf, carpet forming or in small rounded clumps.

PAPUA: Central Division: Mt. Albert Edward, *Brass 4470*, May-July 1933, alt. 3680 m., common in close masses on alpine seepage slopes.

New for both Netherlands New Guinea and Papua. Previously reported from British North Borneo and North-East New Guinea. The specimens agree well with the original description and figure, except that in *Brass 9579* the inflorescence consists of a single spikelet.

Cladium P. Browne

Cladium Meyenii (Kunth) Drake, Ill. Fl. Insul. Maris Pacifici 335. 1892.

Baumea Meyenii Kunth, Enum. Pl. 2: 314. 1837.

Baumea mariscoides Gaud. in Freycin. Voy. Bot. 417. 1826.

Cladium mariscoides (Gaud.) F.Villar in Blanco, Fl. Philipp. ed 3, Nov. App. 309. 1882, non Torr.

Cladium Gaudichaudii W.F.Wight in Contrib. U.S. Nat. Herb. 9: 230. 1905; Ohwi in Bot. Mag. Tokyo 56: 208. 1942.

Cladium Meyenii (Kunth) Drake var. *Gaudichaudii* (W. F. Wight) Kükenth. in Engl. Bot. Jahrb. 69: 260. 1938, in Fedde, Repert. 51: 157. 1942.

SOLOMON ISLANDS: Ysabel: Cape Prieto, *Brass 3478*, Jan. 1933, alt. 200 m., common tussock sedge on dry open hillsides; Cape Prieto, *Brass 3477*, Jan. 1933, alt. 200 m., common ground plant on dry open slopes, small tussocks or clumps on loose soil (leaves and stems of bluish appearance). San Cristobal: Hinuahaoro, *Brass 3021*, alt. 900 m., common on old village site (thick clumps, leaves rather glaucous).

New for the Solomon Islands; previously known from the Hawaiian Islands, Marianne Islands, and North-East New Guinea. The specimens cited above form an interesting series, and it is from their study that I have proposed treating *C. Gaudichaudii* as synonymous with *C. Meyenii*. *Brass 3021* (in flower) and *Brass 3478* (in nearly mature fruit) are good matches for Hawaiian material (*C. Meyenii*). *Brass 3477* has less effuse panicles, with the spikelets more numerous in the fascicles and one piece agrees particularly well with Boeckeler's elaborate description of the type or an isotype of *Baumea mariscoides*.

Drake del Castillo, l.c., cites Bentham & Hooker, Gen. Pl. 3: 1065. 1883, as the authors of *Cladium Meyenii*, but these authors made no such combination, and merely treat *Baumea* as a section of *Cladium*. The name is not listed in Index Kewensis.

Cladium colpodes Lauterb. in Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. Südsee 59. 1905; Valck. Suring. in Nova Guin. Bot. 8: 707. 1912; Kükenth. in Engl. Bot. Jahrb. 59: 52. 1924, 69: 260. 1938, in Fedde, Repert. 51: 155. 1942; Kanehira in Jour. Dept. Agr. Kyushu Univ. 4: 276. 1935.

Cladium globiceps C. B. Clarke in Kew Bull. Add. Ser. 8: 46. 1908.
Cladium juncoides Elmer in Leafl. Philipp. Bot. 3: 854. 1910.
Cladium sinuatum Ridl. in Trans. Linn. Soc. II, Bot. 9: 243. 1916.
Cladium glomeratum (Gaud.) H. Pfeiff. in Fedde, Repert. 23: 349. 1927, non R.Br.
Cladium globiceps C. B. Clarke var. *colpodes* (Lauterb.) Kükenth. in Bull. Jard. Bot. Buitenz. III, 16: 310. 1940.
Cladium Meyenii (Kunth) Drake var. *juncoides* (Elmer) Kükenth. in. Bull. Jard. Bot. Buitenz. III, 16: 310. 1940,* in Fedde, Repert. 51: 157. 1942.
Baumea glomerata Gaud. in Freycin. Voy. 46, *t. 29*. 1826.
Mariscus colpodes (Lauterb.) Fernald in Rhodora 25: 53. 1923.
Mariscus globiceps (C. B. Clarke) Fernald, l.c.

NETHERLANDS NEW GUINEA: Hollandia and vicinity, *Brass 8803,* June-July 1938, alt. 20 m., plentiful in dense somewhat glaucous clumps on partly bare ground of dry deforested slopes.

The species was originally described as *Baumea glomerata* by Gaudichaud, but on its transfer to *Cladium* the epithet *glomeratum* was unavailable owing to the existence of *Cladium glomeratum* R.Br. Prodr. 237. 1810, quite a different plant. C. B. Clarke, l.c., accordingly proposed for it a new name, *Cladium globiceps*. Pfeiffer, however, ignored Brown's earlier homonym, and wrongly took up Gaudichaud's epithet. Both Clarke and Pfeiffer treated *C. globiceps* and *C. colpodes* as distinct species. Kükenthal at first (1924, l.c.) regarded them as conspecific, though later (1938, l.c.) he treated them as varietally distinct. However, in so doing, he erred in not taking up the earlier name *C. colpodes* for the species. Still later (1942, ll.cc.), he treated them as specifically distinct. I have been unable to find any characters to distinguish *C. globiceps*, *C. juncoides* or *C. sinuatum* from *C. colpodes*, and so propose to treat the first three as synonyms of the last-mentioned. *Cladium Meyenii* (Kunth) Drake, of which Kükenthal treats *C. juncoides* as a variety, appears to me to differ by reason of its wider leaves and slightly larger spikelets with larger reddish nuts. In this extended sense *C. colpodes* is fairly widely spread in Malaysia.

Cladium brevipaniculatum (Kükenth.) Kükenth. in Fedde, Repert. 51: 176. 1942.
Cladium Gunnii Hook.f. var. *brevipaniculatum* Kükenth. in Engl. Bot. Jahrb. 69: 260. 1938.

PAPUA: Central Division: Murray Pass, Wharton Range, *Brass 4644*, June-Sept. 1933, alt. 2840 m., growing thickly in a swampy hollow on grassland.

New for Papua; previously known only from North-East New Guinea. The specimen is very young, but appears to belong here. This collection was cited under *Lepidosperma chinense* Nees & Meyen by Kükenthal in Fedde, Repert. 50: 124. 1941, but the absence of hypogynous bristles does not accord with the characters of this genus, and the general facies of the plant is that of *Cladium*.

?**Cladium glomeratum** R.Br. Prodr. 237. 1810.

NETHERLANDS NEW GUINEA: Lake Habbema, *Brass 9443*, Aug. 1938, alt. 3225 m., forming very open tufted stands 1.2–1.5 m. high in sandy marginal shallows and on marshy shores of lake.

* Kükenthal cites *Cladium Meyenii* (Künth.) Benth. et Hook.; see discussion under previous species.

The material is sterile, but appears to belong to this species which is widely spread in Australia, New Zealand and New Caledonia, extending to SE. Asia. In Fedde, Repert. 51: 171. 1942, Kükenthal records it for North-East New Guinea under the name *Cladium rubiginosum* (Soland.) Domin, a name which I have shown to be invalid in Trans. Roy. Soc. S. Austr. 67: 58. 1943, because the basonym *Schoenus rubiginosus* Soland. ex Forst. Prodr. 89. 1786 is a *nomen nudum*.

Cladium undulatum Thw. Enum. Pl. Zeyl. 353. 1864; Kükenth. in Fedde, Repert. 51: 162. 1942.

Cladium undulatum Thw. var. *fimbristyloides* (F. Muell.) Domin in Biblioth. Bot. 20(85): 473. 1915.

Lepidosperma Zeylanicum Lindl. ex Boeck. in Linnaea 38: 332. 1874.

Carpha junciformis Boeck. in Linnaea 38: 267. 1874.

Chaetospora fimbristyloides F. Muell. Fragm. Phyt. Austr. 9: 34. 1875.

Tricostularia fimbristyloides (F. Muell.) Benth. Fl. Austral. 7: 384. 1878.

Schoenus fimbristyloides (F. Muell.) F. Muell. First Census Austral. Pl. 128. 1882.

PAPUA: Western Division: Tarara, Wassi Kussa R., *Brass 8410*, Dec. 1936, savannah-forest, abundant on sour gray soil.

Brass's collection, the only one known from New Guinea, was cited by Kükenthal, l.c. The species ranges from northern Australia to Malaya and Ceylon, and, as indicated in the synonymy above, has been assigned to various genera. From *Chaetospora* (*Schoenus*) and *Carpha* it differs in the more or less spirally arranged glumes and in habit; from the former also in the short internodes of the rhachilla of the spikelet and the nut with its persistent style-base, and from the latter in the broad small nut with short style-base and short not plumose hypogynous bristles. From *Lepidosperma* it differs in foliage and somewhat in inflorescence, in the unthickened hypogynous bristles, and in that it is the lower flower (when more than one is present) which is fertile; the texture of the exocarp of the nut is also different. From *Tricostularia* it differs in foliage and inflorescence, in that it is the lower flower which is fertile, and in the persistent style-base. It differs also from the majority of species usually referred to *Cladium* in habit and in the thin marcescent exocarp of the nut. For the present I have accepted the arrangement of this species proposed by C. B. Clarke in Hook.f. Fl. Brit. Ind. 7: 674. 1894, and followed by Kükenthal, l.c., chiefly because I have seen no specimens from beyond Australia and New Guinea. Kükenthal's description of the leaves of *Cladium undulatum* does not apply to our plant, in which they are spirally arranged and flattened or with involute margins, not distichous and semiterete.

Gahnia J. R. & G. Forster

Gahnia javanica Mor. Verz. Zoll. Pfl. 98. 1845–6; F. Muell. in Trans. Roy. Soc. Vict., n.s. 1(2): 36. 1889; C. B. Clarke in Kew Bull. 1899: 114. 1899; Valck. Suring. in Nova Guin. Bot. 8: 708. 1912.

Gahnia javanica Mor. var. *paupercula* Kükenth. in Engl. Bot. Jahrb. 69: 260. 1938, in Bull. Jard. Bot. Buitenz. III, 16: 307. 1940, in Fedde, Repert. 52: 91. 1943.

Gahnia javanica Mor. var. *longearistata* Kükenth. in Bull. Jard. Bot. Buitenz. III, 16: 307. 1940, in Fedde, Repert. 52: 89. 1943.

Gahnia javanica forma *paupercula* (Kükenth.) Kükenth. apud Benl in Bot. Archiv 40: 173. 1940.

NETHERLANDS NEW GUINEA: 9 km. NE. of Lake Habbema, *Brass 10749*, Oct. 1938, alt. 2800 m., several large clumps (1.8–2 m.) on a native clearing in the forest; 6 km. NE. of Lake Habbema, *Brass 10661*, Oct. 1938, alt. 3000 m., associated with subalpine shrubs on open treeless areas of wet sandy or peaty soil down to about 2800 m. alt.; Lake Habbema, *Brass 9047*, Aug. 1938, alt. 3225 m., abundant on lake shores and drier grasslands, scattered through shrubberies and thickets of peaty ridges (achenes yellow; forms large brownish tussocks); Mt. Wilhelmina, 11 km. NE. of top, *Brass & Meyer-Drees 9704*, Sept. 1938, alt. 3400 m., in grassy valley; Mt. Wilhelmina, 7 km. NE. of top, *Brass & Meyer-Drees 9989*, Sept. 1938, alt. 3560 m., abundant in large clumps in forest glades, grassy borders and open grasslands (fruit yellow).

PAPUA: Central Division: Crest of main Owen Stanley Range, *W. MacGregor*, June 1889 (herb. Melbourne); Murray Pass, Wharton Range, *Brass 4552*, June-Sept. 1933, alt. 2840 m., vary abundant in open grasslands (grows in dense tussocks 25–30 cm. diam.; flowering stems yellow; seeds shining pale brown). Eastern Division: Summit of Mt. Dayman, *W. E. Armit, Jr.*, in 1894 (herb. Melbourne).

Widely spread through Malaysia. *Brass 4552* was cited with the original description of *G. javanica var. longearistata*, but the specimens seen do not well agree with the description, since the lower glumes are at most only very shortly awned. *Gahnia javanica* var. *paupercula* appears to be founded on small reduced specimens with scanty inflorescences. I have not seen the type (*Carr 15237*), nor any specimen which agrees with the character of a 4-noded panicle with solitary or binate partial panicles. Armit's collection, cited by Benl, l.c., under forma *paupercula*, has partial panicles up to 5 per node. *Brass 8477* was cited by Kükenthal (1943, op. cit., 91) under *G. javanica* var. *paupercula*, and on p. 81 under *G. Sieberiana* Kunth. All the material I have seen under this number belongs to *G. Sieberiana*.

The New Guinea material seen by me covers a range of variation from the small reduced plants of *Brass 4552* (46–50 cm. high with binate or ternate partial panicles) to the large plants of *Brass 10749* (at least 1.3 m. high, but up to 2 m., according to the collector's notes, with 3–4-nate partial panicles), but all appears to me to represent a single taxonomic entity. From available descriptions, the Javanese plants differ only in having more numerous partial panicles at each node of the inflorescence, but I have seen only one rather unsatisfactory specimen.

Gahnia aspera (R.Br.) Spreng. Syst. Veg. 2: 114. 1825; F. Muell. Pap. Pl. 2: 69. 1890; Kükenth. in Fedde, Repert. 52: 92. 1943.

Lampocarya aspera R.Br. Prodr. 238. 1810.

PAPUA: Western Division: Tarara, Wassi Kussa R., *Brass 8418*, Dec. 1936, in light rain-forests, clumps 1–1.5 m. high; Tarara, Wassi Kussa R., *Brass 8750*, Jan. 1936, "flowering material of no. 8418"; Mai Kussa R., *W. MacGregor*, Feb. 1890, clay soil with eucalypts (herb. Melbourne); Daru Island, *Brass 8445*, April 1936, abundant with *Scleria* sp. as ground cover in transition mangrove — rain-forest.

In New Guinea known only from the Western District of Papua; elsewhere known from eastern Australia, Polynesia, and parts of Malaysia and Japan. All Brass's collections were cited by Kükenthal.

Gahnia Sieberiana Kunth, Enum. Pl. 2: 332. 1837; Kükenth. in Fedde, Repert. 52: 80. 1943.

Gahnia tetragonocarpa Boeck. in Linnaea 38: 347. 1874; Benl in Bot. Archiv 40: 221. 1940.

NETHERLANDS NEW GUINEA: Balim R., *Brass 11765*, Dec. 1938, alt. 2100 m., plentiful in *Vaccinium* scrubs, on infertile sandy soil (stem-forming species in clumps 2–2.5 m. high; stem and older (erect) branches covered with dry persistent bases of leaves; nuts red).

PAPUA: Western Division: Tumbuke, Wassi Kussa R., *Brass 8477*, Dec. 1936, savannah-forests, clumps of several erect stems to 1 m. long, 4 cm. diam.

Brass 8477 was cited by Benl, l.c., and Kükenthal, l.c., though Kükenthal also cites this number under *G. javanica* var. *paupercula*. *G. Sieberiana* is elsewhere known from eastern Australia and New Caledonia. *Brass 11765* has more acute and slightly larger nuts than most of the Australian specimens I have seen, measuring 3.7–4 mm. long and 1.5–1.8 mm. wide.

Remirea Aublet

Remirea maritima Aubl. Pl. Guian. 1: 45, *t. 16*. 1775; K. Schum. in Notizbl. Bot. Gart. Mus. Berlin 2: 98. 1898; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 198. 1901; Rehd. in Jour. Arnold Arb. 14: 65. 1933; Ohwi in Bot. Mag. Tokyo 56: 209. 1942.

Remirea maritima Aubl. var. *pedunculata* (R.Br.) Benth. Fl. Austral. 7: 347. 1878; K. Schum. & Hollr. Fl. Kaiser Wilhelmsl. 25. 1889; Valck. Suring. in Nova Guin. Bot. 8: 708. 1912; Kükenth. in Engl. Bot. Jahrb. 59: 53. 1924, in Fedde, Repert. 53: 207. 1944; H. Pfeiff. in Fedde, Repert. 29: 184. 1931.

Remirea pedunculata R.Br. Prodr. 236. 1810.

Duval-Jouvea maritima (Aubl.) Palla in Rechinger, Denkschr. Math.-Naturw. Kais. Akad. Wiss. Wien 89: 500. 1913.

NORTH-EAST NEW GUINEA: Constantinhafen (Madang), *Hollrung 506*, in 1887, sandy beach (herb. Melbourne).

PAPUA: Eastern Division: Bomgwina, *Brass 1614*, June 1926, abundant on low sand-dunes.

A pan-tropical strand plant. Brass's collection, the only one yet known from Papua, was cited by Rehder, l.c. Brown, Bentham, and Kükenthal, ll.cc., distinguished the Australian and Malaysian plant on the grounds that the culm is well exserted from the leaves, and this is indeed often the case, but among the Australian plants seen by me in the field there is every gradation from entirely included to well exserted culms, even on the same plant.

Rhynchospora Vahl

Rhynchospora rubra (Lour.) Makino in Bot. Mag. Tokyo 17: 180. 1903; Kükenth. in Engl. Bot. Jahrb. 59: 82. 1924; Ohwi in Bot. Mag. Tokyo 56: 204. 1942.

Rhynchospora Wallichiana Kunth, Enum. 2: 289. 1837; Valck. Suring. in Nova Guin. Bot. 8: 706. 1912.

Rhynchospora Wallichii (Nees) K.Schum. in K.Schum. & Hollr. Fl. Kaiser Wilhelmsl. 25. 1889, apud Warb. in Engl. Bot. Jahrb. 13: 266. 1891; K.Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 198. 1901.

Schoenus ruber Lour. Fl. Cochinch. 1: 41. 1790.

Morisia Wallichii Nees in Edinb. New Phil. Jour. 17: 265. 1834.

NORTH-EAST NEW GUINEA: Augusta (Sepik) R., *Hollrung 835* (herb. Melbourne).

PAPUA: Western Division: Lake Daviumbu, Middle Fly R., *Brass 7845*, Sept. 1936, scattered over wet savannahs and grass plains; Gaima, Lower Fly R. (east bank), *Brass 8352*, Nov. 1936, open savannah-forest, common on moister soils (det. Kükenthal); Dagwa, Oriomo R., *Brass 5997*, Feb.-March, 1934, alt. 40 m., abundant on damp slopes and flats in savannah forest and on open country (erect, yellow green; inflorescence brown); Wuroi, Oriomo R., *Brass 5707*, Jan.-March 1934, alt. 10–30 m., abundant on lower savannah ridges; Wuroi, Oriomo R., *Brass 5709*, Jan.-March, 1934, alt. 10–30 m., abundant on gray soil savannah ridges; Tarara, Wassi Kussa R., *Brass 8640*, Jan. 1937, savannah forests, common on acid gray soils; Mai Kussa R., *W. MacGregor* in 1890 (herb. Melbourne). Eastern Division: Sudest Island, *W. MacGregor* in 1889 (herb. Melbourne).

New for Papua; widely spread in the warmer parts of the Old World.

Rhynchospora heterochaeta S. T. Blake in Proc. Roy. Soc. Queensl. 51: 47. 1940.

PAPUA: Western Division: Wuroi, Oriomo R., *Brass 5730*, Jan.-March 1934, alt. 10–30 m., plentiful on damp ground on savannahs; Daru Island, *Brass 6405*, March 1936, common on swampy gray soil in savannah-forests (inflorescence brown, plant stiff, glossy green) (det. Kükenthal).

New for New Guinea; previously known from Queensland, Northern Territory, Java and Philippine Islands. *Brass 5730* was cited by Kükenthal under *R. longisetis* R.Br. subsp. *exserta* (C. B. Clarke) Kükenth., comb. nova, in Bull. Jard. Bot. Buitenz. III, 16: 303. 1940. This combination is based on *R. exserta* C. B. Clarke, an allied species with stouter, much longer hypogynous bristles and a stout style-base as broad as the nut. At least some, if not all the other collections cited by Kükenthal, l.c., with the exception of the one from North Australia (the type of *R. exserta*) belong to *R. heterochaeta*. The remarks also refer to *R. heterochaeta*. *Brass 5730* was also cited under the same trinomial in Engl. Bot. Jahrb. 70: 463. 1940.

Rhynchospora corymbosa (L.) Britton in Trans. N. Y. Acad. Sci. 11: 84. 1892; Kükenth. in Engl. Bot. Jahrb. 59: 52. 1924.

Rhynchospora aurea Vahl, Enum. 2: 229. 1806; F. Muell. Pap. Pl. 1: 74. 1876; K. Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. Südsee 60, 1905; Valck. Suring. in Nova Guin. Bot. 8: 706. 1912.

Scirpus corymbosus L. Cent. Pl. 2: 7. 1756.

PAPUA: Western Division: Lake Daviumbu, *Brass 7633*, Sept. 1936, abundant on floating islands in lake (leaves smooth and shining, upper surface showing a bluish metallic sheen). Central Division: Koitaki and Sogere, *C. T. White 274*, July-August, 1918, in wet ground; Port Moresby, *Goldie* (herb. Melbourne); near Port Moresby, *Edelfeldt 208* in 1884 (herb. Melbourne).

SOLOMON ISLANDS: San Cristobal: Magoha R., *Brass 2750*, Aug. 1932, in clumps 1.5 m. high on 20 ft. silt banks, common.

Pantropical, but apparently not previously recorded for the Solomon Islands.

Rhynchospora triflora Vahl, Enum. 2: 232. 1806.

PAPUA: Western Division: Gaima, Lower Fly R. (east bank), *Brass 8356*, Nov. 1936, occasional in shallow swamps in savannah forest.

New for New Guinea; previously recorded from Ceylon and Tropical America, though there is also a specimen from Malaya in herb. Brisbane (Pahang: Tasek Bera, *M. R. Henderson in Singapore Field no. 24101*, October 1930; distributed from the Botanic Gardens, Singapore, as *Rhynchospora glauca* Vahl).

Rhynchospora Brownii R. & S. Syst. 2: 86. 1817; Ohwi in Bot. Mag. Tokyo 56: 205. 1942.

Rhynchospora laxa R.Br. Prodr. 230. 1810; non Vahl.

Rhynchospora chinensis Nees & Meyen ex Nees in Wight, Contrib. 115. 1834.

Rhynchospora glauca Vahl var. *chinensis* (Nees & Meyen) C. B. Clarke in Hook.f. Fl. Brit. Ind. 6: 671. 1894, quoad syn.

NETHERLANDS NEW GUINEA: Balim R., *Brass 11742*, Dec. 1938, alt. 1800 m., common in grass on sandy, long deforested slopes; Balim R., *Brass 11815*, Dec. 1938, alt. 1600 m., common grass associate on sandy, long deforested slopes; 9 km. NE. of Lake Habbema, *Brass 10725*, Oct. 1938, alt. 2800 m., several slender clumps in a native clearing.

PAPUA: Central Division: Urunu, Vanapa Valley, *Brass 4790*, July-Aug. 1933, alt. 1900 m., scattered in small clumps on open grasslands.

New for Papua. Spread over Malaysia and the warmer parts of Asia and Australia. It has commonly been identified with the American *R. glauca* Vahl and was referred to this species by Rendle in Gibbs, Phyt. Fl. Arfak Mts. 91. 1917, and by Kükenthal in Engl. Bot. Jahrb. 69: 259. 1938. From the description, *R. glauca* var. *condensata* Kükenth., l.c., (*R. Brownii* var. *condensata* (Kükenth.) Ohwi, l.c.) appears not to be taxonomically different. *Rhynchospora glauca*, of which the legitimate name is *R. rugosa* (Vahl) Gale in Rhodora 46: 275. 1944, differs from the plant of the Eastern Hemisphere in having smaller spikelets and smaller more distinctly rugose nuts with an acute style-base. *Rhynchospora glauca* var. *chinensis* (Nees) C. B. Clarke is founded nomenclaturally on *R. chinensis* Nees, but the description and specimens are of a different plant for which the legitimate name appears to be *R. japonica* Makino in Bot. Mag. Tokyo 17: 184. 1903. It is apparently this plant which Ohwi, l.c., refers to "**Rhynchospora chinensis** Nees et Meyen ex Nees in Wight, Contr. (1830) 115, emend. Böcklr. in Linnaea 37 (1873) 586." But Boeckeler's "emendation" does not alter the fact that (nomenclaturally at least) the concept of the species still rests on the type of Nees & Meyen.

QUEENSLAND HERBARIUM,

BRISBANE, QUEENSLAND, AUSTRALIA.

ON THE CONTROL OF DESTRUCTIVE INSECTS IN THE HERBARIUM

E. D. MERRILL

ONE PROBLEM with which most curators of herbaria are concerned is the protection of the collections under their charge against the depredations of destructive insects. The chief offender is the cigarette or tobacco beetle, known in botanical circles as the herbarium beetle, *Lasioderma serricorne* (Fabr.). There are other offenders such as the drug-store beetle, *Stegobium paniceum* (Linn.), but the *Lasioderma* is the most common one. Whatever means prove to be effective in controlling or eliminating the distinctly serious herbarium beetle, will, in general, apply to all other insects that are destructive to stored botanical specimens.

Lasioderma serricorne (Fabr.) is of cosmopolitan distribution, infesting tobacco wherever it is stored. Regarding it, Mallis* says: "The foods upon which it feeds are legion, and a few of these are rice, ginger, raisins, pepper, dried fish, dates, belladonna, drugs, seeds, and pyrethrum powder. They like older tobaccos apparently because they possess a strong odor." Apparently cured tobacco is its most favored food, or at least one of its most favored ones. The life history of the insect is completed in from 70 to 90 days. In temperate climates the insects swarm first in May and again in August. In some parts of the United States there may be three generations in a year; in tropical regions there are as many as five or six overlapping generations within a year. In the humid tropics and even in the warm humid parts of the southeastern United States destruction of herbarium material by these insects is much greater than in cooler regions. However, in heated buildings it is surmised that breeding may take place throughout the year, as is the case in the tropics. The eggs hatch in from six to ten days. The larval stage lasts from five to ten weeks; it is in this stage that herbarium specimens are damaged. At temperatures of about 60° F. the larvae become dormant and may then hibernate. The prepupal and pupal stages last from two to three weeks. Adult beetles may live from three to four weeks. This brief outline is given because of its importance in reference to control by fumigation or by other means. Single fumigations at long intervals are ineffective.

In herbarium practice, from a historical standpoint, controls have taken the form of tight cabinets, sometimes difficult to attain when wood is used, as is generally the case; by actual poisoning of the specimens; and by fumigation. In some institutions repellents are used to a certain degree. Any experienced curator will realize that such controls are only in part effective, for there is always the human element to consider. To keep any

* **Mallis, A.** Handbook of pest control. 340. 1945.

herbarium free from the depredations of the herbarium beetle and other destructive insect pests involves constant attention. Not infrequently, in little consulted material, the actual destruction of important specimens may reach distinctly large proportions before an infestation is detected.

In earlier years arsenic was effectively utilized, but its use has long since been abandoned because it is a cumulative poison, and in too many cases arsenic poisoning developed among herbarium workers because of their exposure to arsenic dust. Today the most generally used poison is a saturated alcoholic solution of corrosive sublimate to which phenol is sometimes added. This is a very poisonous mixture and has to be handled with great discretion; mercury is also a cumulative poison. It is a well known fact that even when specimens are dipped in the solution and redried before mounting; or when the mounted specimens are sprayed with the solution, or it be painted over the material with a soft brush, permanent protection is not attained. In the course of time the corrosive sublimate becomes inert. When this happens fumigation and repoisoning are necessary. The treatment is expensive in time and in material, and cannot be considered as efficient. Not infrequently specimens that have been thoroughly poisoned with corrosive sublimate are utterly destroyed by the herbarium beetle. Unfortunately, when specimens are poisoned it may give responsible curators a false sense of security.

At the Gray Herbarium and at the Arnold Arboretum specimens are not poisoned, dependence being placed on tight steel cases combined with fumigation when necessary. The first tight steel cases in botanical history was the beginning of the extensive installation of excellently designed ones at the Gray Herbarium in 1905, followed by the Arnold Arboretum installation in 1908–09. Since the first installation of steel cases in Cambridge the use of them has been greatly extended, but as yet in the majority of the large herbaria of the world dependence is still placed on wooden cases, which, unfortunately, are not always too tight.

It is, in some herbaria, standard practice to fumigate all cases at least once each year. Theoretically with modern tight steel cases, an herbarium should be reasonably free from infestation by the herbarium beetle and similar pests; practically this is not the case for by one means or another gravid female beetles will gain access to stored material; naturally the case doors have to be opened very frequently, and sometimes, through carelessness, they may remain open for relatively long periods of time. With unpoisoned or even poisoned material in storage in the cases this is an invitation to future trouble.

The basic installation at the Arnold Arboretum is represented by an extensive series of modern steel cases. As noted above none of the specimens are poisoned. A decade ago the herbarium beetle infestation here was very extensive throughout the building, mature beetles, pupae and larvae occurring in great abundance in all parts of the large collection; and this in spite of the fact that a few years earlier the entire building had been closed, sealed as tightly as possible, and fumigated with hydrocyanic

acid gas. The situation in 1936 was so critical and destruction so great that one large room was sealed and refumigated with hydrocyanic acid gas. All of the steel cases were fumigated individually, and this fumigation was repeated several times. Through this fumigation campaign naturally not all of the viable eggs, larvae, pupae, and mature beetles were destroyed, but the number of insects was very greatly reduced.

Realizing that fumigation alone, unless repeated at frequent intervals, was not to be depended upon, any more than when all specimens were poisoned with the corrosive sublimate solution, repellents in the form of naphthalene flakes and paradichlorobenzene were placed in each case. In the steel cases this mixture, about two thirds naphthalene and one third paradichlorobenzene was placed in muslin bags, a bag reasonably full of the mixture placed in each case, in an upper pigeon-hole. For the cartons* (and actually in excess of 3,000 of these are now in use for temporary storage of both mounted and unmounted material) a paper flap was pasted on the bottom near the back of each carton, under which was placed a large handful of the repellent. It has been current practice to renew the repellent once each year. It is admitted that the use of these substances may be objectionable for occasionally an individual may be allergic to one or both of them; yet with the cases closed the odor in the building is never strong, and is normally in no way objectionable. In fact the odor is scarcely noticeable at any time except near a recently opened case.

There is, of course, always the chance of reinfestation of stored collections even if the specimens be poisoned, even if the cases are tight, and even if repellents are used. Naturally the combined naphthalene-paradichlorobenzene fumes within the cases are not in sufficient concentration to be lethal to either the eggs, the larvae, the pupae, or the adult insects. It is, however, a manifest fact that the odor is very objectionable to the insects and that the gravid female will always choose unprotected material as a place for depositing her eggs, if there be any choice.

It is not claimed that the extensive fumigation campaign in 1936–37 destroyed all of the thousands of herbarium beetles that at that time thoroughly infested the reference collections at the Arnold Arboretum. With large collections of incoming material constantly being received from all parts of the world there was always the chance of reinfestation. As a matter of fact the greatest danger of reinfestation is returned in loans from other institutions, and duplicate material received from such institutions as exchanges. In some recently returned loans the destruction of the specimens while away for study purposes was so great that some drastic step seemed to be called for. For the present this has merely taken the form of a sticker, printed in red ink and attached to all outgoing loan forms, reading:

"Important Notice

In recent years we have had the sad experience of finding that certain returned loans of important historical botanical material were badly in-

* **Merrill, E. D.** An economical herbarium case. Torreya **26**: 50–54, *fig. 1–2*. 1926.

fested with herbarium beetles. In one particular case the essential parts of many important specimens were utterly destroyed during the time the material was on loan, reducing their value to a minimum. Please safeguard this loan against the ravages of herbarium beetles throughout the period of the loan by the liberal use of insect repellents such as naphthalene or paradichlorobenzene. *These specimens have not been poisoned and hence are particularly subject to the ravages of herbarium pests.*"

Our actual loans within the past decade have varied from a minimum of about 1000 to a maximum of 4000 or an average of about 2500 mounted sheets per year. All material borrowed from other institutions for study purposes, and these borrowings averaged 3000 per year during the past decade, is fumigated immediately on receipt of a shipment. In the decade the total receipt of specimens from all sources, including duplicates, approximate 430,000 to which may be added about 65,000 sheets in the form of borrowed specimens and returned loans, or a grand total of nearly 500,000 specimens, all to be considered as potential sources of reinfestation of our herbarium by the herbarium beetle.

In current practice all incoming material is thoroughly fumigated, whether this consists of new collections as received from the field, exchanges from other institutions, purchased material, borrowed sheets and returned loans. All material, as mounted, is placed in tight cases well supplied with the repellent. Even before a distribution into the herbarium such material, after being placed in family arrangement, is refumigated. Such steps have been considered to be necessary to avoid adding infested specimens to the reference collections. Special care has been taken to see that the doors of all cases be kept tightly shut except as it was necessary to open them when material was being studied, removed, or added. A study collection taken out even for a period of only a few weeks, is always fumigated before the specimens are returned to permanent storage.

It is now about eight years, since these regulations went into full force. In that period no staff member, visiting botanists or students have reported seeing live beetles, larvae, or pupae in the building. This is, indeed, a very striking contrast to a decade ago when the infestation was very great; so great that one could find quantities of live beetles, larvae, and pupae, more or less embedded in the strips of felt against which the doors of the steel cases close. In this period the number of staff members who use herbarium material all or a part of their time has varied from the neighborhood of eight to ten individuals; and this takes no account of scores of visiting botanists and students who have consulted our material. All investigators were requested to watch for signs of insect damage and for live insects, and if any of the latter were observed, to report the matter at once; there have been no reports of infestation in the period covered. The herbarium now contains approximately 700,000 mounted sheets, with many additional thousands of unmounted specimens in storage, with vast collections of undistributed duplicate material of one type or another. None of the specimens is poisoned. Considering the tremendous infestation of a

decade ago, and the situation that still exists in certain other large herbaria, this is indeed a remarkable record.

It is a well known fact that the herbarium beetle is very selective. Entire families of plants are more or less immune to their attacks, although it is admitted that they will destroy flowers of most species in most families, as well as soft fruits and soft vegetative parts. Curiously the Gramineae, which yields most of the forage on which herbiverous mammals subsist, are, in general, free from the depredations of the herbarium beetle except in those genera which have pithy stems more or less charged with sugar or starch, such as *Zea*, *Saccharum*, and allied genera. Another monocotyledonous group that is also remarkably free from their depredations is the Cyperaceae. In those families having sclerophyllous or leathery tough leaves, such as most of the Coniferae, the Palmae, as to their leaves, the Myrtaceae, the Lauraceae, the Guttiferae, many genera of the Ericaceae, and numerous other families, damage is normally slight except to the flowers. In the tropics, even when all material had been poisoned with the corrosive sublimate solution, I have noticed serious damage even to the sedges and some grasses, as well as to the ferns and fern allies, mosses, and lichens. One may assume that no single natural group of plants is wholly immune to attack. Certain it is that the flowers of all or most species are vulnerable.

Generally speaking certain natural families of flowering plants are peculiarly susceptible to damage or destruction by herbarium insects. Whether or not the gravid females are attracted by certain odors is not known, but it is suspected that this is the case. It is a well known fact that stored herbarium material in certain families is characterized by distinctive odors, such as the Caprifoliaceae, Umbelliferae, Araliaceae, Labiatae, Compositae, etc. all highly susceptible groups. However, distinctive odors are not in general associated with material representing other preferred families such as the Solanaceae, Scrophulariaceae, Capparidaceae, Cruciferae, Asclepiadaceae, Apocynaceae, Moringaceae, Tropaeolaceae, Papavaraceae, Ranunculaceae, Nymphaeaceae, Liliaceae, Araceae, and certain genera of the Leguminosae and Rosaceae, all groups that are especially attractive to the herbarium beetle larvae. It is to be noted that the majority of the species in most, but not all, of these families are predominantly herbaceous. It seems highly probable that the gravid female insects may be attracted by certain glucosides, alkaloids, or food elements in representatives of the above families, as well as by distinctive odors. Whatever the attraction is, it is clear that the families listed above are the preferred ones, and stored specimens representing them are those most frequently damaged or even destroyed by these herbarium pests. It may be noted that the same elements (glucosides) which give the characteristic taste to most representatives of the Cruciferae, occur also in the Tropaeolaceae and the Moringaceae; all or most of the representatives of these three families of plants are peculiarly susceptible to attack by the herbarium beetle. Usually it is largely the flowers and the tender leaves that

are destroyed; but in unprotected Umbelliferae often the whole plant is devoured, even the somewhat lignified stems of certain species. At any rate an experienced and observant curator can cite cases of utter destruction of important material in such families as those above listed through the unchecked ravages of active and rapidly increasing colonies of herbarium beetles.

This selectiveness of the gravid females as to preferred food plants gave me an idea which I put into practice following the last comprehensive fumigation of our herbarium cases nine years ago. A selection was made from common species to which the herbarium beetle is notedly partial, such as *Asclepias*, *Apocynum*, representatives of the milky Compositae such as *Sonchus* and *Taraxacum*, and selected genera in the Solanaceae (including *Nicotiana*), Umbelliferae, Cruciferae, Papaveraceae, Labiatae, and Scrophulariaceae. Wherever possible selection was made on the basis of tenderness of vegetative parts and abundance of flowers. Quantities of roughly dried herbarium specimens were prepared. This material was placed loose on specimen sheets and tied in unwrapped bundles about six inches thick. Twelve of these bundles of preferred plants, "bug traps" if you wish, were numbered, dated, and placed in strategic places in all rooms where herbarium material was stored or handled. About four times each year these "bug traps" are picked up, fumigated, redated, and returned to their positions in the building. The evidence is that, following fumigation, the use of repellents, plus the installation of the "bug traps," is what has kept a once very badly infested, large herbarium, and one in which none of the specimens are poisoned, entirely free (as far as our observations go) from infestations of the herbarium beetle for a period of eight years. In that period the only material that has suffered has been that loaned to specialists in other institutions for study purposes.

There is another group of much smaller insects which are destructive in a limited sense, which many curators overlook or perhaps ignore. These are the so-called book lice, representatives of the Psocidae, which thrive on pollen, even when the specimens have been poisoned by corrosive sublimate. Thus it is that pollen experts, turning to this or that herbarium for material, are sometimes disappointed by discovering that these nefarious little insects have anticipated them by destroying all of the pollen grains in both open and unopened anthers. They are controlled even easier than the herbarium beetle by the use of repellents. It is possible that certain Thysanoptera do a certain amount of damage to stored herbarium material on occasion, especially where the humidity is high. These, and all other insects which thrive on dried herbarium specimens are easily controlled by the simple methods outlined above.

It is admitted that the installation of "bug traps" which I advocate, may be a potential source of reinfestation of stored herbarium material, whether this be poisoned or unpoisoned. There is thus a certain human element in the picture. However, if all the "bug traps" be picked up at regular intervals, a minimum of four times a year at three months inter-

vals, and thoroughly fumigated before they are replaced, there is no danger. In practice it would doubtless be advisable to replace the material that make up the "bug traps" occasionally; here this has been done only once since the first installation was made eight years ago.

I believe that our experience over a decade, with not a single live beetle, pupa, or grub reported in the last eight years, rather definitely demonstrates the efficacy of this very simple and relatively inexpensive method of eliminating these herbarium pests. The scheme is practicable, efficient, and what is more, inexpensive; in fact much less expensive in time and in material than the current practice, in some large herbaria, of poisoning all material with corrosive sublimate before the mounted sheets are distributed into the herbarium, to say nothing of repeated fumigations. Perhaps the very simplicity of the plan will militate against its general use, but definitely it is worth a thorough trial. About the only chances of reinfestation, once a herbarium is free from these destructive pests, would be to forget to renew the repellent in the cases (this should be done once a year), to forget to pick up and fumigate all the "bug traps" at proper intervals (once in about three months); to fail to fumigate all incoming material, including exchanges, recently collected material coming in from the field, borrowed material, and returned loans. A potent source of reinfestation is material that has been exposed in institutions where it is known that bad infestations exist, including exchanges, loans, and borrowed specimens. Admittedly my observations are based entirely on empiricism, i.e., observation; but never-the-less the simple scheme works. I unhesitatingly recommend it to all curators of herbaria who are faced with the really serious problem of protecting their collections against the ravages of destructive insects.

From our experience it is not necessary to look upon the presence of from few to many of these destructive insects in any herbarium as a necessary evil and one that cannot be avoided. It has been demonstrated, through our experience over a decade, that the herbarium beetle and other secondary herbarium pests can be thoroughly and economically controlled by the simple method outlined above, and this without the use of poison, or poisonous gases other than the desirable preliminary fumigations. Not one of our numerous steel cases has been fumigated in eight years, or since the "bug traps" were installed; and no infestations have been discovered in the thousands of cartons now in use. The entire herbarium, consisting of approximately 700,000 mounted sheets, none of the material poisoned with corrosive sublimate, is now free from infestation, and it is anticipated that it will remain free as long as the present practice of fumigation of all incoming material, free use of repellents, and the maintaining of "bug traps" with their fumigation at regular intervals, is followed.

Father Hugh O'Neill* has demonstrated the fact that heat may be efficiently used in the control of herbarium pests. If the temperature be raised to 140° F. (60° C.) this is sufficient to kill insects in all stages of

* **O'Neill, H.** Heat as an insecticide in the herbarium. Rhodora 40: 1–4. *1 fig.* 1938.

development and within a few minutes. Because of the nature of the stored material it takes four or five hours at a temperature of 170° F. (77° C.) to attain this end, as paper is a poor conductor of heat and of course it is necessary to raise the temperature in the center of the bundles to that required for lethal purposes. Most institutions are not equipped to apply this heat treatment, although at the University of Montreal each storage case is equipped with an electrical heating unit. The use of a partial vacuum is very effective in killing insects. Here the initial installation is expensive, and because the bulky herbarium material must be transported to and from the vacuum chamber, the labor costs are high; this same statement applies when herbarium material must be transported to a heat equipped unit.

It is believed that some of the modern insecticides such as DDT may prove to be very efficient either sprayed over the specimens or merely sprayed over the interior surface of the storage units. Father O'Neill reports to me that with sprayed specimens difficulties may develop, for certain individuals are allergic to DDT dust. In one case that he mentioned the difficulties were so great that spraying of specimens has been discontinued and now dependence is placed on spraying the interior of the storage units. Perhaps this spraying of the interior surfaces of the pigeon holes occasionally may suffice; at any rate it is distinctly worth a thorough trial. We do know from our own experience over the past decade that the combination of fumigation, use of repellants, and the installation of "bug traps" is very effective.

I have noted above that there is always the human element to be considered. Unless curators assume their proper responsibilities and keep constantly on the alert for indications of the presence of the herbarium beetles, no matter what system be followed reinfestation may occur at any time during the breeding season of the insects involved. Proper precautions and eternal vigilance on the part of responsible officials is the price that an insect free herbarium exacts. The cooperation of all staff members and of others who have occasion to consult stored material is important, and this whether the specimens be poisoned or not. Whether an infestation be light or severe, it should be attended to immediately once it is discovered. To delay in applying control methods is merely to invite disaster in the form of the destruction of often very valuable and utterly irreplaceable specimens.

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THE NOMENCLATURE OF THE FLOWERING DOGWOOD AND ITS ALLIES

HIROSHI HARA

DR. MERRILL HAS RECENTLY MENTIONED that the botanist who deals with monographs or local floras should at least take Rafinesque's names into consideration. This statement well applies to the case of modifying the genus *Cornus* in a broad sense. Since Dr. Nakai,[1] in 1909, divided *Cornus* into four genera and then carefully revised his opinion in Flora Sylvatica Koreana XVI, Cornaceae (1927), his followers in Japan have been supporting his classification. In 1942 Dr. Hutchinson completely agreed with Dr. Nakai's opinion on this subject, although he unfortunately overlooked Dr. Nakai's second paper, and added two new genera: *Afrocrania*, a monotypic genus from tropical Africa, and *Dendrobenthamia*, a group of the Japanese flowering dogwood.

For a group of the flowering dogwood in North America, both authors adopted *Cynoxylon* Rafinesque (1838) as a generic name, following Small and Britton. It is my opinion,[2] however, that Rafinesque intended to publish the name *Cynoxylon* as a subgenus of *Cornus*, not as a genus. At first Rafinesque proposed *Cynoxylon* as a section name of *Cornus* in his Medical Flora Vol. 1, p. 132 (1828). Then he published it with a formal description on page 59 of his Alsographia Americana (1838) as follows:

"257. EUKRANIA Raf. florib. pedicel. umbellatis, . . . trees and plants — Types C. mascula, canadensis and suecica. Krania and Mesomora were grecian names of the Cornels.

"258. CYNOXYLON Raf. (dog-wood) petalis obtusis, florib. sessilib. subcapitatis, involucris 4 phylis coloratis ineq. emarg. fruct. distinctis, oblongis, fol. oppos. — Type C. florida, distinguished since 1828.

"259. BENTHAMIA Lindl. non Rich. Raf. sylv. tel. 817 different Cynoxylon, drupis coalitis concretis (syncarpes) ut in Morus — Type B. or Cornus fragifera Wallich."

On the preceding page of the same work, *Mesomera* and *Kraniopsis* were clearly designated as subgenera of *Cornus*. *Eukrania* and *Cynoxylon* without exact indication have often been considered genera. For the following reasons, it is rather clear, I think, that Rafinesque intended *Cynoxylon* as a subgenus. In the first place, in the index on page 76 of the same work, *Eukrania* and *Cynoxylon* are both written in italics which was explained to denote subgenera. Secondly, he made no binomial combinations under either name. This case has been discussed in detail by Farwell.[3] If *Eukrania* and *Cynoxylon* had been considered as genera

[1] NAKAI, Cornaceae in Japan. Bot. Mag. Tokyo 23: 35–45. 1909.

[2] When I investigated this problem in 1940, I came to the following conclusion independently. Through the courtesy of Dr. Merrill, I have now noted the recent discussions on the same subject by Rickett and Farwell published in Torreya 42: 11–14, 130, 131. 1942.

by Rafinesque, he would have mentioned at least under *Eukrania* as "Types E. or Cornus mascula, . . ." instead of "Types C. mascula, . . ." as in the case of *Benthamia* Lindl., which was clearly regarded as an independent genus. Thirdly, in his Sylva Telluriana (p. 130), which was published in the same year as Alsographia Americana, he clearly noted under *Benthamia* Lindl. that "very singular G. (= genus) uniting the Cornides with Nauclides, very near to my subg. Cynoxylon of med. fl. 1828." So, according to my interpretation, Rafinesque in 1838 published *Cynoxylon* and *Eukrania* as well as *Mesomera* and *Kraniopsis* as subgenera of *Cornus*. Although Jackson in Index Kewensis 1: 689. 1893 listed *Cynoxylon* as a genus, it was not validly published as a genus until Small adopted it in 1903. Therefore, the earliest correct generic name for the flowering dogwood is *Benthamidia* Spach published in 1839 and based on *Cornus florida* L., as Dr. H. N. Moldenke has adopted it.

A group of the Japanese flowering dogwood in Asia, i.e. *Dendrobenthamia* Hutch., differs from the American species of the flowering dogwood by having ovaries and fruits perfectly united into a fleshy globose syncarp. A similar difference is sometimes observed within a single genus, as for example in *Lonicera*, and to my way of thinking it is not sufficient for generic separation, since they agree otherwise in important morphological, anatomical and cytological characters. On this point I quite agree with Dr. Nakai in regarding both the New and Old World species of the flowering dogwood as a single genus, and in recognizing two sections based on fruiting characters. I now propose the following treatment under the generic name *Benthamidia:*

Benthamidia Spach, Hist. Nat. Vég. Phan. 8: 106. 1839, emend. Hara.
Cornus Sect. *Involucratae* DC., Prodr. 4: 273. 1830, pro parte.
Cornus Sect. *Benthamia* (Lindl.) Koehne, Deutsch. Dendr. 435, 438. 1893.
Benthamia Lindley sensu Nakai in Bot. Mag. Tokyo 23: 40. 1909.
Cynoxylon Rafin. sensu Nakai, Fl. Sylv. Korea. 16: 67. 1927.

Benthamidia Sect. 1. **Cynoxylon** (Rafin.) Hara, comb. nov.
Cornus Sect. *Cynoxylon* Rafinesque, Medic. Fl. 1: 132. 1828.
Cornus Subgen. *Cynoxylon* Rafinesque, Alsogr. Amer. 59. 1838.
Benthamidia Spach, l.c. 1839.
Cornus Sect. *Tanycrania* Endlicher, Gen. Pl. 2: 798. 1839, pro parte.
Cornus Gruppe *Benthamidia* (Spach) K. Koch, Dendr. 1: 694. 1869.
Cynoxylon Rafin. ex Jackson, Ind. Kew. 1: 689. 1893; Small, Fl. SE. United States, 854. 1903; Britton, N. Amer. Trees 744. 1908; Hutchinson in Ann. Bot. n.s. 6: 91. 1942.
Cornus Sect. *Discocrania* Harms et *Benthamidia* (Spach) Harms in Nat. Pflanzenfam. III. 8: 267. 1897.
Benthamia Subgen. *Apocarpea* Nakai Sect. *Benthamidia* (Spach) et Sect. *Discocrania* (Harms) Nakai, l.c. 41. 1909.
Cornus Subgen. *Benthamidia* K. Koch ex Schneider, Ill. Handb. Laubh. 2: 453. 1909.
Cornus Subgen. *Discocrania* (Harms) et *Benthamidia* (Spach) Wangerin in Engl. Pflanzenreich IV. 229(Heft 41): 84–86. 1910.

[3] FARWELL, Eukrania and Cynoxylon not genera of Rafinesque. Rhodora 34: 29–30. 1932.

1. **Benthamidia florida** (L.) Spach, Hist. Nat. Vég. Phan. 8: 107. 1839.
Cornus florida L., Sp. Pl. 117. 1753.
Cynoxylon florida (L.) Rafin. ex Jackson, Ind. Kew. 1: 689. 1893; Hutchinson, l.c. 92. 1942.
Benthamia florida (L.) Nakai in Bot. Mag. Tokyo 23: 41. 1909, in nota.

DISTRIBUTION: Eastern North America (Maine, S. Ontario, Minn. to Florida, Texas).

Benthamidia florida f. **rubra** (André) Hara, comb. nov.
Cornus florida var. *rosea* Carr. & André in Rev. Hort. 1891: 369. 1891.
Cornus florida var. *rubra* André in Rev. Hort. 1894: 500, *t*. 1894.
Cynoxylon floridum var. *rubrum* (André) Moldenke in Bull. Torrey Bot. Club 60: 56. 1933.
Benthamidia florida var. *rubra* (André) Moldenke in Torreya 34: 8. 1934.
Cornus florida f. *rubra* (West) Palmer & Steyermark in Ann. Missouri Bot. Gard. 22: 612. 1935.

Benthamidia florida f. **pendula** (Dipp.) Hara, comb. nov.
Cornus florida pendula Anon. in Wien. Ill. Gart.-Zeit. 12: 508. 1887.
Cornus florida var. *pendula* Dippel, Handb. Laubh. 3: 244. 1893.
Cynoxylon floridum var. *pendulum* (Dipp.) Moldenke, l.c. 56. 1933.
Benthamidia florida var. *pendula* (Dipp.) Moldenke, l.c. 8. 1934.

Benthamidia florida f. **pluribracteata** (Rehder) Hara, comb. nov.
Cornus florida f. *pluribracteata* Rehder in Jour. Arnold Arb. 7: 243. 1926.

Benthamidia florida f. **xanthocarpa** (Rehder) Hara, comb. nov.
Cornus florida var. *xanthocarpa* Rehder, Man. Cult. Trees Shrubs 673. 1927.
Cornus florida f. *xanthocarpa* Rehder, l.c. ed. 2, 688, 1940.

Benthamidia florida var. **urbiniana** (Rose) Hara, comb. nov.
Cornus urbiniana Rose in Contrib. U. S. Nat. Herb. 8: 53. 1903.
Cornus florida var. *urbiniana* (Rose) Wangerin in Engl. Pflanzenreich IV. 229 (Heft 41): 87. 1910.
Cornus florida subsp. *urbiniana* (Rose) Rickett in Bull. Torrey Bot. Club 72: 223. 1945.

DISTRIBUTION: Mexico.

2. **Benthamidia Nuttallii** (Audubon) Moldenke in Phytologia 1: 167. 1935.
Cornus Nuttallii Audubon, Birds N. Amer. t. 367. 1837; ed. nov. 4: 313, t. 279. 1842; Torrey & Gray, Fl. N. Amer. 1: 652. 1840.
Cynoxylon Nuttallii (Audubon) Shafer in Britton & Shafer, N. Amer. Trees 746, fig. 684. 1908; Hutchinson, l.c. 92. 1942.
Benthamia Nuttallii (Audubon) Nakai in Bot. Mag. Tokyo 23: 41. 1909, in nota.

DISTRIBUTION: Western North America (British Columbia to S. California).

3. **Benthamidia disciflora** (Moc. & Sessé ex De Candolle) Hara, comb. nov.
Cornus disciflora Moc. & Sessé ex De Candolle, Prodr. 4: 273. 1830.
Cornus grandis Chamisso & Schlechtendal in Linnaea 5: 171. 1830.
Benthamia disciflora (Moc. & Sessé) K. Koch, Hort. Dendr. 285. 1853.
Benthamia disciflora (Moc. & Sessé) Nakai et *grandis* (Cham. & Schlecht.) Nakai in Bot. Mag. Tokyo 23: 41. 1909, in nota.
Cynoxylon disciflorum (Moc. & Sessé ex De Candolle) Hutchinson, l.c. 91. 1942.

DISTRIBUTION: Central Mexico and Costa Rica.

Benthamidia disciflora var. **floccosa** (Wangerin) Hara, comb. nov.
Cornus floccosa Wangerin in Fedde, Rep. Nov. Sp. 6: 101. 1908.
Cornus disciflora var. *floccosa* (Wanger.) Standley in Field. Mus. Publ. Bot. 8: 321. 1931.
Cynoxylon floccosum (Wanger.) Hutchinson, l.c. 91. 1942.

Cornus disciflora f. *floccosa* (Wanger.) Rickett in Bull. Torrey Bot. Club 72: 223. 1945.

DISTRIBUTION: Mexico.

Benthamidia Sect. 2. **Cephalocrania** (Hance) Hara, comb. nov.

Benthamia Lindley in Bot. Reg. 19: t. 1579. 1833; non A. Richard (1828), nec Lindley (1830).

Cornus Sect. *Cephalocrania* Hance in Jour. Linn. Soc. 13: 105. 1873, in textu.

Cornus Sect. *Benthamia* (Lindl.) C. B. Clarke in Hooker, Fl. Brit. Ind. 2: 745. 1879.

Cornus Sect. *Benthamia* (Lindl.) Koehne, Deutsch. Dendr. 435. 1893.

Benthamia Subgen. *Syncarpea* Nakai Sect. *Eubenthamia* Nakai in Bot. Mag. Tokyo 23: 41. 1909.

Cornus Subgen. *Benthamia* Benth. & Hook. ex Schneider, Ill. Handb. Laubh. 2: 454. 1909.

Cornus Subgen. *Benthamia* (Lindl.) Wangerin in Engl. Pflanzenreich IV. 229(Heft 41): 88. 1910.

Cynoxylon Sect. *Benthamia* (Koehne) Nakai, Fl. Sylv. Korea. 16: 68. 1927, cum Subsect. *Japonicae* Nakai.

Dendrobenthamia Hutchinson in Ann. Bot. n.s. 6: 92. 1942.

4. **Benthamidia japonica** (Sieb. & Zucc.) Hara, comb. nov.

Benthamia japonica Sieb. & Zucc., Fl. Jap. 1: 38, t. 16. 1836; Nakai in Bot. Mag. Tokyo 28: 314. 1914, cum *α typica*, *β minor* et *γ exsucca* Nakai.

Cornus Kousa Buerger ex Miquel in Ann. Mus. Bot. Lugd.-Bat. 2: 159. 1865, pro syn.; Hance in Jour. Linn. Soc. 13: 105. 1873; Masamune & Nakamura in Trans. Nat. Hist. Soc. Formosa 33: 56, fig. 1, 2. 1943.

Cornus japonica Thunb. sensu Koehne, Deutsch. Dendr. 438. 1893; non Thunberg 1784.

Benthamia Kousa (Buerg.) Nakai in Bot. Mag. Tokyo 23: 41. 1909.

Benthamia viridis Nakai, Chosen-Shokubutsu 1: 426. Mar. 1914, in textu jap., in Bot. Mag. Tokyo 28: 314. Nov. 1914.

Cynoxylon japonica (Sieb. & Zucc.) Nakai in Bot. Mag. Tokyo 31: (148). 1917, in textu, Fl. Sylv. Korea. 16: 69, t. 19–22, 1927, cum var. *typica*, f. *minor*, var. *exsucca* et var. *viridis* Nakai.

Cynoxylon Kousa (Buerg.) Nakai ex Mori, Enum. Pl. Corea. 275. 1922, nom. seminud.

Dendrobenthamia japonica (Sieb. & Zucc.) Hutchinson, l.c. 93. 1942.

DISTRIBUTION: Honshu, Shikoku, Kyushu, Loochoo, Formosa, and Central and Southern Korea.

Benthamidia japonica var. **chinensis** (Osborn) Hara, comb. nov.

? *Benthamia chinensis* Hort. ex Lavalée, Arb. Segrez. 129. 1877, pro syn.

Cornus Kousa Buerg. sensu Rehder in Pl. Wilson. 2: 577. 1916; Bean in Curtis's, Bot. Mag. t. 8833. 1920; Hu, Icon. Pl. Sin. 1: t. 42. 1927.

Cornus Kousa var. *chinensis* Osborn in Gard. Chron. ser. 3, 72: 310. 1922; Bean in Kew Bull. 1926: 321, t. 8. 1926; Rehder, Man. Cult. Trees Shrubs 673. 1927.

Cynoxylon sinense Nakai in Jour. Jap. Bot. 15: 741. 1939.

DISTRIBUTION: China (Kiangsu, Chekiang, Anhwei, Hupeh, Kiangsi, Hunan, Kwangtung, Shensi, Szechuan, Kweichow, Yunnan).

Benthamidia japonica var. **angustata** (Chun) Hara, comb. nov.

Cornus Kousa Buerg. var. *angustata* Chun in Sunyatsenia 1: 285. 1934.

DISTRIBUTION: China (Kwangtung).

5. **Benthamidia hongkongensis** (Hemsl.) Hara, comb. nov.

Benthamia japonica Sieb. & Zucc. var. *sinensis* Bentham in Hooker, Jour. Bot. & Kew Misc. 4: 165. 1852.

Cornus hongkongensis Hemsley in Jour. Linn. Soc. 23: 345. 1888; Chun in Sunyatsenia 1: 281. 1934.
Benthamia hongkongensis (Hemsl.) Nakai in Bot. Mag. Tokyo 23: 41. 1909, in nota.
Cynoxylon hongkongensis (Hemsl.) Nakai in Jour. Jap. Bot. 15: 742. 1939.
Dendrobenthamia hongkongensis (Hemsl.) Hutchinson, l.c. 93. 1942.

DISTRIBUTION: China (Chekiang, Kwangtung, Kwangsi, Kweichow, Yunnan) and Indo-China (Tonkin).

Benthamidia hongkongensis var. **gigantea** (Hand.-Mzt.) Hara, comb. nov.
Cornus hongkongensis var. *gigantea* Hand.-Mzt., Symb. Sin. 7(3): 690. 1933.

DISTRIBUTION: China (Yunnan).

6. **Benthamidia ferruginea** (Wu) Hara, comb. nov.
Cornus ferruginea Wu in Bot. Jahrb. 71: 199. 1940.

DISTRIBUTION: China (Kwangtung, Kwangsi).

7. **Benthamidia capitata** (Wall. ex Roxb.) Hara, comb. nov.
Cornus capitata Wallich ex Roxburgh, Fl. Ind. ed. Carey, 1: 434. 1820; Wallich, Pl. Asiat. Rar. 3: 10, t. 214. 1832.
Benthamia fragifera Lindley in Bot. Reg. 19: t. 1579. 1833.
Benthamia capitata (Wall.) Nakai in Bot. Mag. Tokyo 23: 41. 1909, in nota.
Cynoxylon capitata (Wall.) Nakai in Cat. Semin. Hort. Bot. Univ. Tokyo, 1918: 22. 1918, nom. nud., in Jour. Jap. Bot. 15: 742. 1939.
Dendrobenthamia capitata (Wall.) Hutchinson, l.c. 93. 1942.

DISTRIBUTION: China (Hupeh, Kiangsi?, Hunan, Kwangtung?, Kwangsi, Szechuan, Kweichow, Yunnan), Indo-China (Tonkin, Laos), Upper Burma and Himalaya.

Benthamidia capitata var. **khasiana** (Clarke) Hara, comb. nov.
Cornus capitata var. *khasiana* C. B. Clarke in Hooker, Fl. Brit. Ind. 2: 745. 1879.

DISTRIBUTION: Himalaya (Khasia).

Benthamidia capitata var. **mollis** (Rehder) Hara, comb. nov.
Cornus capitata var. *mollis* Rehder in Pl. Wilson. 2: 579. 1916.
?*Cornus capitata* var. *hypoleuca* Léveillé, Cat. Pl. Yunnan 59. 1916.

DISTRIBUTION: China (Hupeh and Yunnan?).

For those botanists who are unfamiliar with Dr. Nakai's paper in 1927, a few additional notes to Dr. Hutchinson's article will be interesting. The earliest author who adopted a pre-Linnean name, *Chamaepericlymenum*, is Hill, and he used it for the dwarf honeysuckle as a generic name in the British Herbal p. 331 (1756). *Macrocarpium officinale* (Sieb. et Zucc.) Nakai is a native of Korea, and in Japan it is only cultivated in the garden.

In completing this paper, the author wishes to express his deepest gratitude to Dr. Merrill for his very kind and helpful advice.

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JOURNAL
OF THE
ARNOLD ARBORETUM

VOL. XXIX APRIL 1948 NUMBER 2

A TAXONOMIC REVISION OF PODOCARPUS
III. THE AMERICAN SPECIES OF PODOCARPUS: SECTION POLYPODIOPSIS

NETTA E. GRAY AND JOHN T. BUCHHOLZ

With one plate

Podocarpus Rospigliosii Pilger has been known only since 1923 from the type locality in Peru when Pilger (10) described an unnamed specimen in the Berlin Herbarium and noted its affinities with *P. vitiensis,* but he considered both as belonging to the section *Nageia.* This specimen was sent by Dr. C. J. Rospigliosi from the Museo de Historia Natur. de la Univers. de Lima, *#556 leg. N. Esposto,* and is represented by a photograph and fragment in the Field Museum collection of type specimens. Earlier, in 1903, Pilger (9) had recognized the similarity between *P. vitiensis*, the Fijian member of this section, and two sterile specimens from unspecified localities in the equatorial Andes (Colombia, *Stübel 171[b]*, and Venezuela, *Funck et Schlimm 1208*). It was Florin (6) who revived Bertrand's (4) category *Polypodiopsis* as a section which now includes *P. vitiensis, P. minor* and *P. Rospigliosii.*

No specimen was available in American collections from South America until very recently when four were recognized, all in the United States National Herbarium (one of them accompanied by a seed), having been referred to *P. montanus* in section *Stachycarpus* because of the very superficial resemblance of foliage. Four recent collections from Colombia have been added by the same Herbarium and four more appeared among the plants collected in Venezuela by Steyermark of the Chicago Museum of Natural History (several with half-grown and fully mature seeds) with duplicates in the Herbarium of the University of Illinois.

Podocarpus Rospigliosii, with its flat leafy branches resembling the compound leaves of a fern, is recognizable from its external morphology. It is the only American species of *Podocarpus* with stomata on both sides of the leaf. The leaves are opposite; all other easily confused species have alternate leaves. Florin (6, 7) has shown that they are four-ranked as the

leaf traces emerge from the stele, but the leaves are twisted at the base and bent around, so that they are actually spread out in a single plane with all leaves on one side of the twig exposing their abaxial surfaces toward the observer, while the leaves on the opposite side of the twig expose their adaxial surfaces. This accounts for the differentiation in development of palisade parenchyma and stomata on the upper and lower sides of the leaf. When the abaxial surface is exposed to the light, more palisade is developed on the abaxial side and more stomata on the adaxial. When the adaxial surface is exposed to the light, little or no palisade may be developed on the abaxial side. Since both sides of the leaves have stomata and can scarcely be distinguished, this peculiar phyllotaxy may be recognized externally only from the decurrent leaf bases and the characteristic twisting of these leaves that brings the four ranks into the same plane.

The number and position of the resin canals separate *P. Rospigliosii* from all known members of *Podocarpus*. It is the only American species which normally has three resin canals under the vascular bundle. Some leaves show only one, others may have five, the additional two being located under the transfusion tissue. The lateral resin canals vary in number from two to six. When there are only two, these are rarely located at the extreme margin of the blade, but an increase to four or six shows them in the margin or at the end of the transfusion tissue. These resin canals do not arise by division of existing resin canals at the base of the leaf. The largest number are present in the middle of the blade, and they disappear toward the ends. No more than eleven resin canals have been observed in any leaf and the two sides of the leaf may vary, as two on one side and three on the other. The structure of the canal is normal — a cavity of varying size bounded by a ring of resin excreting cells. In unstained cross sections, the resin in the cavity shows a greenish color.

The position of the resin canals in the section *Polypodiopsis* has been touched on twice in the literature. Bertrand (4) described one vascular and two marginal resin canals for *P. vitiensis* from Fiji. This would be the only *Podocarpus* in the western Pacific having marginal resin canals. Unfortunately, this specimen is unavailable for re-examination and examples from six localities, found in American herbaria and identified as *P. vitiensis*, have shown only the single vascular canal and no marginal ones. Mahlert (8) noted the resin canals in a specimen in the Leipzig Herbarium labelled *Polypodiopsis*, in which he found one resin canal directly under the phloem, which becomes three, and four lateral canals, one in the center of each side and one marginal. He believes this specimen to be the same as that described by Bertrand with one median and two marginal resin canals. We are wondering if some early American collections, inadequately labelled or labels lost and having found their way into European collections, may have been referred to Bertrand's section *Polypodiopsis* by comparison with material from the South Pacific. However, Mahlert describes the original three resin canals of Bertrand as dividing to

form the additional canals he observed. In *P. Rospigliosii*, there is no such branching of resin canals. It is entirely possible that Mahlert's specimen is another species in the section *Polypodiopsis* and that it is even more closely related to *P. Rospigliosii*.

Podocarpus Rospigliosii shows some leaf characteristics in common with section *Afrocarpus*. Both are amphistomatic, have hypoderm on both sides interrupted by the rows of stomata, transfusion tissue usually extending far into the blade of the leaf and large fibres reinforcing the vascular bundle, show tapered margins in cross section, and lack accessory transfusion tissue. These similarities are worthy of note in consideration of the position of the section *Polypodiopsis* in the *Podocarpus* complex.

This species is of special interest to paleobotanists since a Tertiary fossil species in this category has been found in Chile which has been the subject of considerable study. Originally the fossils in question had been referred to *Sequoia* by Engelhardt (5). They were the basis of reports of the occurrence of this genus in the Southern Hemisphere and widely quoted. Berry, who had accepted these determinations in an early treatise (1), was the first to challenge the identifications as Sequoias and identified one of them as *Araucaria araucoensis* (2); later he decided that none of these fossils represent Sequoias and referred another to *Podocarpus* as *P. Engelhardtii* (3). Florin (4), recognizing in some of these specimens the peculiar phyllotaxy with opposite paired leaves, decurrent leaf bases and especially the cuticular structures of the leaves, placed one of these fossils in the genus *Podocarpus, P. araucoensis* (Berry) Florin, belonging to the section *Polypodiopsis*. Thus there are according to both Berry and Florin no fossils belonging to *Sequoia* in the Southern Hemisphere based upon the original group of fossils referred to this genus. Moreover, we know definitely that members of this section *Polypodiopsis* were present on the South American continent during the Eocene.

8. **Podocarpus Rospigliosii** Pilger in Notizbl. Bot. Gard. Berlin 8: 273, 1923, in Nat. Pflanzenfam. 13: 245. 1926; Florin in Svenska Vet.-Akad. Handl. 3(10): 192–194, 275. 1931, 19: 9–12. 1940; Macbride, Flora of Peru, 1 (Field Mus. Nat. Hist. Publ. 351, Bot. ser. 13): 85. 1936; Schnee in Bol. Soc. Venezol. Cienc. Nat. 9: 183, fig. 1. 1944.

Podocarpus montanus sensu Knuth in Fedde, Repert. Sp. Nov. Reg. Veg. Beih. 43: 95. 1928, not Lodd.

An evergreen tree 30–35 m. tall with flat frondose branches and twigs, clothed with ovate-lanceolate leaves, opposite, sessile, up to 22 mm. long and 5 mm. wide in the lower parts of twigs grading down to 11 mm. long and 2.5 mm. wide toward the tips of the twigs. Leaves amphistomatic with median vein, spread out in one plane by twisting at the base with adaxial sides exposed on one side of the twigs and with abaxial sides of leaves exposed on the opposite side, as indicated externally by decurrent leaf bases and internally by orientation of xylem and phloem in vascular bundles. Buds naked. Leaves internally with hypoderm on both sides of the leaf interrupted by the stomata even at the midrib, vascular schlerenchyma of large fibres constantly present on the upper or xylem side and of smaller fibres rarely present on the lower or phloem side (not altered

by orientation). Single median vascular bundle flattened in cross section and flanked by transfusion tissue extending laterally into the leaf tissue, but no accessory transfusion tissue nor isolated sclereids in the mesophyll. Palisade tissue developed on both sides of leaf depending upon exposure. Resin canals 3–11, the median one situated beneath the vascular bundle.

"The male cones are placed at the apex of rather short, lateral axillary shoots borne by ordinary leafy branchlets. Each fertile shoot shows two to a few pairs of reduced and scale-like leaves (decussate arrangement; no twisting of the leaf bases). It carries one male cone terminally on the axis, and adjacently to this two cones in the axils of the uppermost pair of scales, and two more cones may in addition be placed in the same way, but some distance from the shoot apex."*

Ovulate cones placed at the apex of short axillary shoots attached to the thicker branches rather than the more slender twigs. Each fertile shoot shows two growth zones belonging to two different seasons' growth. Leaves of the older part usually smaller than vegetative leaves with twisting of leaf bases unless these leaves are reduced to scales, while the last season's growth includes two to four or more pairs of broader ovate-orbicular decussate bracts (sterile cone scales) not twisted and appearing more gray-glaucous. The single inverted ovule borne in terminal position, with a single ovate bract on the side away from the micropyle. This ovular, slightly keeled bract, 4 mm. long by 3 mm. wide, persists and while essentially free from the ovule, adheres sufficiently near its base to fall away with the seed. Both ovules and seeds have a small crest at the terminal end.

Seed obovoid, 20–30 mm. long and 12–18 mm. wide, not flattened, with micropyle below. The seed coat consists of an outer layer which becomes fleshy, a stony layer 1 mm. thick and an inner layer enclosing the endosperm. Both the stony layer and endosperm plus nucellus narrow to a conical spine or point at the micropyle, but covered by the fleshly layer of the seed so that this spinelike point is not observed unless the outer layer is removed. At the opposite end near the crest the stony layer is rounded. Hence, the crest is wholly a part of the fleshy layer, and may be broken off on mature seeds. These fruits become colored from blue-black to red, have been reported as edible (presumably as nuts) and are very attractive when ripe.

DISTRIBUTION: Mountains of western Venezuela, eastern Colombia and Central Peru at altitudes between 1700 m. and 2600 m.

SPECIMENS EXAMINED:

COLOMBIA. Dept. Antioquia: *W. A. Archer 541* (with seeds in pocket) from cultivation in Fredonia [fig. 37] (†US). Dept. Cundinamarca: San Francisco, Cordillera Oriental, *Garcia-Barriga 11038* (US, [fig. 35] †Ill, with developing seeds attached); *Garcia-Barriga 11041* (†US); *Garcia-Barriga 11586* (US); Estación San Bernardo, *Dugand & Jaramillo 3962* (US).

VENEZUELA. Tachira: between La Grita and Yetuines, *Jahn 99* (†US); above La Grita, *Steyermark 57112* (F, †Ill). Merida: no locality data, *Pittier 12756* (†US); above La Carbonera, *Steyermark 56049* (F, †Ill); Canagua, *Steyermark 56370* (F, †Ill); no locality data, *Sardi 6672* (Ven, †Ill); above Jaji, *Steyermark 55999*, with ovules, mature seeds in pocket [figs. 38, 39] (F, †Ill).

* From Florin (7), who personally examined the type specimen in the Herbarium of the Berlin Museum. Most of these details may be observed under magnification in Macbride's photograph of the type specimen (F).

PERU. Prov. Junin: Oxapampa, *Esposto 556 type*, photo and fragment (†F); †fragment of Berlin specimen sent by Dr. Florin; *Soukup 1801 topotype* (†US, [fig. 36] Ill); seedling, *Soukup 1801* (Ill).

There is considerable variability in the specimens examined with respect to the size of the leaves, their internal anatomy, and the seeds. In general, young branches of vigorously growing trees and lower branches are likely to have the longest leaves, which also vary due to position on the same twig. Old trees bearing reproductive branches usually have leaves that average much smaller. The seeds are shown in figures 38 and 39. Although this material occurs in the Andes at sites from 8° north of the Equator to 12° south latitude, the variations were found to intergrade and not to separate into categories. Only careful observations by field collectors and foresters will determine the existence of sub-species or varieties.

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EXPLANATION OF PLATE

PLATE V

FIGS. 35–39. *Podocarpus Rospigliosii* Pilg. FIG. 35. *Garcia-Barriga 11038* (Ill) showing numerous female cones with single terminal ovules enlarging after pollination. This specimen has the smaller leaves usually associated with reproductive branches × 7/8. FIG. 36. Twig from *Soukup 1801* (Ill) from vegetative branches with larger leaves. × 7/8. FIG. 37. *Archer 541* (US) Central part and one side of transverse section, above middle of leaf, showing 6 of its 9 resin canals. Vascular bundle has flattened form in cross section, but at this level, the transfusion tissue is not always developed into extreme wing-like extensions (cf. FIG. 4). Leaves are amphistomatic; hypoderm is interrupted (always where there are stomates occasionally in places without stomates) on both sides of leaf. × 60. FIG. 38. Seed from *Steyermark 55999* (Ill). Bract may be seen at back of seed away from micropyle. × 7/8. FIG. 39. Old seeds collected from litter under tree of same, showing seed intact at center, with outer layer partially removed at left and right, exposing micropylar spine-like extensions below × 7/8.

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A TAXONOMIC REVISION OF PODOCARPUS

IV. THE AMERICAN SPECIES OF SECTION EUPODOCARPUS, SUB-SECTIONS C AND D

JOHN T. BUCHHOLZ AND NETTA E. GRAY

With eight plates

THERE IS NOW a large amount of *Podocarpus* material, Section *Eupodocarpus,* available in American herbaria which has made possible new interpretations of old material and brought to light a number of new entities in the regions of Central and South America. The group of plants considered as a whole are characterized by a wide variation in size of plant, from shrub to tree over 35 m. tall, and in appearance of the evergreen foliage, the leaves varying from 1.5 cm. to 24 cm. long and 3 mm. to 22 mm. wide. The leaves are symmetrically flattened and in leaf cross-section uniformly show upper hypoderm, a single vascular bundle with a single resin canal below and flanked by wing-like transfusion tissue, stomata only on lower surface, and palisade only on the upper side. Sub-section D, represented in this region by the single species, *P. nubigenus,* has the only American species in this section without organized accessory transfusion tissue and was noted by Orr (The Leaf Anatomy of Podocarpus in Trans. Proc. Soc. Edinburgh 34 (1): 1–54. 1944). All other species belong to Sub-section C and show well-developed accessory transfusion tissue extending from above and below transfusion tissue to margin of leaf. The upper hypoderm was found to be interrupted only in *P. guatemalensis,* its varieties *pinetorum* and *Allenii, P. Cardenasii, P. Sprucei,* and *P. salignus.* Orr found interrupted hypoderm also in *P. Parlatorei* but in the examination of four specimens from Argentina and one from Bolivia we found no evidence of interruption. Auxiliary sclereids in palisade and mesophyll were first described by Orr in *P. oleifolius.* These are a constant character of *P. pendulifolius, P. Pittieri, P. Rusbyi,* and *P. Matudai;* are usually present in leaves of mature trees of *P. magnifolius* and are absent in about a third of the collections of *P. oleifolius* and its varieties. Fibers accompanying the vascular bundle are consistently absent in *P. Lambertii, P. Lambertii* var. *transiens, P. glomeratus, P. Cardenasii, P. Sprucei, P. tepuiensis, P. guatemalensis* (not its varieties) and *P. Parlatorei;* are only rarely absent in *P. coriaceus, P. oleifolius* and *P. Reichei;* and are often absent in *P. Purdieanus, P. Urbanii,* and *P. salignus.*

KEY TO SECT. EUPODOCARPUS (AMERICAN SPECIES), SUB-SECT. C AND D

Accessory transfusion tissue absent. *Sub-sect. D.*
29. *P. nubigenus.*

Accessory transfusion tissue well-developed. *Sub-sect. C.*
Leaves not pungent or spine-tipped.
Leaves relatively large, broad, flat, usually more than 6 cm. long, 5 mm. wide; terminal bud scales long-acuminate, 3–4 or more times as long as wide.
Upper surface of leaf flat or very slightly grooved with the groove between two ridges above midvein, becoming essentially flat toward the tip; hypoderm continuous above.
Leaves with vascular sclereids; without accessory sclereids.
Leaves linear-lanceolate, attenuate, elongate-falcate, usually 10–13 cm. or more long, 10–15 mm. wide. Upper epidermal cells 55–119 microns long. Female peduncles 7–10 mm. long; seed usually more than 8 mm. long, ridged along back and bluntly crested (Caribbean).....1. *P. coriaceus.*
Leaves lanceolate, rather short angustate, acuminate, 6–10 cm. long, 5–15 mm. wide, the lower leaves petioled; epidermal cells 24–66 microns long. Female peduncles 4–7 mm. long; seed up to 7 mm. long.
Leaves 6–10 cm. long, 7–12 mm. wide. Pollen cones 3 cm. long (Brazil).....2. *P. Sellowii.*
Leaves 6 cm. long, 5–9 mm. wide. Pollen cones 1–2 cm. long.....2a. *P. Sellowii* var. *angustifolius.*
Leaves with both vascular sclereids and accessory sclereids, linear-lanceolate, attenuate, falcate, 8–14 cm. long, 8–15 mm. wide, flat above except for ridge at petiole and upwards. Female peduncles 11–24 mm. long, slender. Seed nearly spherical or somewhat pear-shaped, 10–12 mm. long or longer, ridged along back and crested (Venezuela).....3. *P. Pittieri.*
Upper surface of leaf raised above midvein, leaves usually 6–10 cm. long, 5–7 mm. wide.
Hypoderm interrupted above. Male cones axillary, solitary though aggregated near tip of branchlets, filiform, 3–3.5 cm. long, about 1 mm. wide. Seeds narrowly oblong-ovoid with a large blunt crest. Epidermal cells 15–40 microns wide (S. Chile).....20. *P. salignus.*
Hypoderm continuous above. Leaves large, 6–15 cm. long, epidermal cells 8–20 microns wide.
Lower vascular and auxiliary sclereids both absent. Female peduncles 9–18 mm. long; seeds sub-globose, more than 12 mm. long (Mexico).....4. *P. Reichei.*
Vascular sclereids and auxiliary sclereids both present.
Female peduncles short, not over 7 mm. long; seeds less than 10 cm. long.....5. *P. Matudai.*
Female peduncles long, 9–18 mm. long; seeds very large, more than 12 mm. long.....5a. *P. Matudai* var. *macrocarpus.*
Leaves large (more than 6 cm. long and 5 mm. wide, with a distinct groove above the midvein) or small (with or without groove and less than 6 cm. long and 5 mm. wide).
Bud scales long, slender-attenuate, 3–4 times as long as wide.

Leaves with a ridge above midvein, or a groove between two ridges, sometimes becoming flat toward tip, at most 5 cm. but usually less than 3 cm. long, oblanceolate. Hypoderm continuous above; vascular sclereids present; auxiliary sclereids absent. Female peduncles 5 mm. long, receptacle 6 mm.; seed 6 mm. long (N. Brazil).....6. *P. Roraimae.*

Leaves with a distinct groove on upper side above midvein.

Leaves more than 4 cm. long; epidermal cells 32–74 microns long.

Leaves linear-lanceolate, 4–8 cm. long, 6–11 mm. wide, with revolute margin; stiffly arched-spreading, recurved; vegetative bud scales very large, becoming foliaceous (Venezuela).....7. *P. Steyermarkii.*

Leaves ovate-lanceolate, oblong or obovate, thick and stiff, 5–12 cm. long, 12–17 mm. wide (on vigorous shoots and saplings up to 17 cm. long and 24 mm. wide)..... .....8. *P. magnifolius.*

Leaves less than 4 cm. long, lanceolate, somewhat channeled, 2–3.5 cm. long, 4–7 mm. wide. Vascular and auxiliary sclereids both present; epidermal cells 11–22 microns long. Female peduncles 3–4 mm. long; receptacle well developed, conically spreading, often 2-seeded; seeds 7 mm. long (Bolivia).....9. *P. Rusbyi.*

Bud scales ovate, acute, obtuse or apiculate but not attenuate.

Bud scales apiculate.

Leaves small, less than 2.5 cm. long, 4–6 mm. wide, divaricately spreading, with a distinct groove above midvein, lanceolate. Vascular sclereids and auxiliary sclereids both absent (SE. Venezuela).....10. *P. tepuiensis.*

Leaves large, more than 4 cm. long and 7 mm. wide.

Leaves essentially flat above, upper hypoderm continuous.

At least some of the leaves on reproductive branches spine-tipped, with a ridge beneath midvein. Vegetative bud scales apiculate and very thick at base, leaving transverse rhomboidal scars on stem (Jamaica).....11. *P. Purdieanus.*

Leaves never spine-tipped, oval, flat above or with only an inconspicuous groove between low ridges above and having a shallow 1 mm. wide groove beneath midvein (Trinidad).....12. *P. trinitensis.*

Leaves linear-lanceolate with a ridge above midvein; upper hypoderm interrupted.

Vascular sclereids and auxiliary sclereids absent. Vegetative buds small with scales having relatively long apiculus (Guatemala, Brit. Honduras)..... .....13. *P. guatemalensis.*

Vascular sclereids present, auxiliary sclereids absent. Vegetative buds larger, bud scales obtuse, often short-apiculate.

Epidermal cells 22–66 microns long (Brit. Honduras).....13a. *P. guatemalensis* var. *pinetorum.*

Epidermal cells 11–31 microns long (Panama)..... .....13b. *P. guatemalensis* var. *Allenii.*

Vegetative bud scales acute or obtuse, usually not apiculate.

Leaves flat above or nearly so.

Leaves small, less than 4 cm. long (except in juvenile specimens), sometimes with a spine at tip, auxiliary sclereids absent.
Pollen cones fascicled; leaves erect or sub-patent.
Leaves broadly linear, acute or obtuse, very thick. Pollen cones fascicled in 6 or more, on a scaly or leafy peduncle 15–20 mm. long, branched near top. Vegetative buds large, globose, with thin scales acute, obtuse or apiculate (Ecuador and Colombia).....21. *P. Sprucei.*
Leaves linear-lanceolate, moderately thick, broadly acute, 3–4 cm. long, 3–4 mm. wide. Vegetative bud scales obtuse or acute, not apiculate. Pollen cones fascicled in 3–6 on a naked peduncle up to 10 mm. long (Brazil)...22. *P. Lambertii.*
Pollen cones axillary; leaves patent or more spreading, linear-lanceolate, usually with a pungent spine at tip, sometimes without, 2.5–3 cm. long or longer. Pollen cones cylindrical, 4–5 mm. in diameter, on very short peduncles. Vegetative bud scales broad, acute or obtuse (Jamaica).....14. *P. Urbanii.*
Leaves large, more than 6 cm. long, essentially flat (or with suppressed or inconspicuous groove between two ridges above), angustate, falcate, becoming 11 cm. long and drooping, with margin smooth and swollen, never revolute; auxiliary sclereids present (W. Venezuela)..... .....15. *P. pendulifolius.*
Leaves with a distinct groove above midvein.
Leaves large, usually more than 3–4 cm. long, 7 mm. wide; vascular and auxiliary sclereids present.
Leaves linear-lanceolate, attenuate. Male cones sessile. Female peduncles 5–10 mm. long; seeds spherically elongated, their crests small (S. Mexico to Peru)..... .....16. *P. oleifolius.*
Leaves oblanceolate (or oval) broadly acute or obtuse; pollen cones on peduncles 3–5 mm. long; seeds relatively longer than above, ridged at back, with prominent crest..... .....16a. *P. oleifolius* var. *macrostachyus.*
Leaves intermediate between the above species and variety; pollen cones peduncled; female peduncles and seeds similar to *P. oleifolius* (Costa Rica)... .....16b. *P. oleifolius* var. *costaricensis.*
Leaves somewhat longer and wider than var. *macrostachyus,* tending to be more obtuse rather than attenuate. Seeds as in var. *macrostachyus* but on peduncles 10–18 mm. long (W. Venezuela)...16c. *P. oleifolius* var. *trujillensis.*
Leaves small, less than 2 cm. long and 7 mm. wide. Vegetative buds ovate acute, scales usually apiculate. Vascular and auxiliary sclereids both absent (SE. Venezuela)..... .....10. *P. tepuiensis.*
Leaves tipped by a spine (pungent).
Vegetative buds with scales acuminate or long-apiculate.
Leaves with accessory transfusion tissue. Pollen cones numerous, fascicled or grouped on a common peduncle.

Leaves broadly linear, rather short angustate, 1.5–5 cm. long, 2–4 mm. wide.

Leaves erect to sub-patent, 3–5 cm. long, 3–4 mm. wide, often with a broad open groove above. Female peduncles 3–5 mm. long. Hypoderm continuous (Peru).....17. *P. glomeratus.*

Leaves divaricate, 1.5–3 cm. long, 2–3 mm. wide, usually flat above, pale green and glaucous beneath; hypoderm interrupted (Bolivia).....18. *P. Cardenasii.*

Leaves narrowly linear, long-attenuate, 5–12 cm. long, up to 2.5 mm. wide. Female peduncles 7–8 mm. long; seed sub-globose, about 5 mm. long (Bolivia, Argentina).....19. *P. Parletorei.*

Leaves without accessory transfusion tissue, linear-lanceolate with 2 broad glaucous bands beneath (on each side of midvein). Pollen cones rarely fascicled or individually solitary and sometimes peduncled, may be aggregated near ends of twigs (sub-section D above).....29. *P. nubigenus.*

Vegetative buds with scales apiculate or obtuse.

Bud scales apiculate.

Leaves large 7–9 cm. long, 10–12 mm. broad, oblong-lanceolate, shiny above with midvein scarcely manifest, stiffly short mucronate (juvenile or vigorous lower branches may have larger leaves and lack the spine) (Jamaica).....11. *P. Purdieanus.*

Leaves less than 7 cm. long.

Leaves elliptical, 3–5 cm. long.

Leaves narrowly elliptical, 7–10 mm. wide. Female peduncle 3–5 mm. long, receptacle 4–5 mm. long. Seed 8–9 mm. long, conically crested (Cuba)...23. *P. Leonii.*

Leaves broadly elliptical, 10–13 mm. wide; female receptacle 15–20 mm. long. Seed 10 mm. long with connical crest (Cuba).....24. *P. Victorinianus.*

Leaves linear or lanceolate, 1–4 cm. long.

Leaves linear, about 4 cm. long, 6–7 mm. wide; female peduncle 3–4 mm. long; receptacle 5–7 mm. long; seed 7–8 mm. long (Cuba).....25. *P. angustifolius.*

Leaves elliptical, about 4 cm. long, 6–7 mm. wide; female peduncle about 3–4 mm. long; receptacle 6–7 mm. long; seed 7–8 mm. long (Cuba).....26. *P. aristulatus.*

Leaves 1.2–2 cm. long, 3–4 mm. wide; female cone sessile (or peduncle 1 mm. long), receptacle 4–7 mm. long, 3–4 mm. wide; seed 6–7 mm. long, crested (Cuba).....27. *P. Ekmanii.*

Vegetative bud scales obtuse, seldom with minute apiculus.

Leaves lanceolate, with and without a pungent spine at apex, less than 5 cm. long.

Leaves 2.5–3 cm. long or longer, 4–5 mm. wide, usually (but not always) spine-tipped. Pollen cones solitary and axillary. Female cone on a very short peduncle (Jamaica).....14. *P. Urbanii.*

Leaves 1.5–2.8 cm. long, 4–6 mm. wide, with sharp pungent 1–1.5 mm. long spine (Haiti).....28. *P. Buchii.*

Leaves similar, somewhat broader (Haiti).....28a. *P. Buchii* var. *latifolius.*

Leaves linear or linear-lanceolate.

Pollen cones fascicled 6 or more, on a branched scaly or leafy peduncle 15–20 mm. long; leaves erect or sub-patent, linear or broadly linear, up to 4 cm. long or longer. Seed sub-globose. Hypoderm interrupted (S. Colombia, Ecuador)...21. *P. Sprucei.*

Pollen cones fascicled, 3–6 on naked peduncle, up to 10 mm. long. Leaves narrowly oblong or linear-lanceolate, erect or patent, broadly acute, 3–4 cm. long, 3–4 mm. wide. Seed subglobose. Hypoderm continuous.

Leaves narrow.....22. *P. Lambertii.*

Leaves broader, up to 5 cm. long, 5 mm. wide.....22a. *P. Lambertii* var. *transiens.*

1. **Podocarpus coriaceus** L. C. Richard in Ann. Mus. Hist. Nat. Paris 16: 297. 1810 (nomen), Comm. Bot. Conif. 14, pl. 1, fig. 3, 1826, not Hooker; Endlicher, Syn. Conif. 210. 1847, in part; Pilger in Pflanzenreich IV. 5(Heft 18): 87. 1903, in part; Urban in Symbolae Antill. 4: 71. 1903; Dallimore & Jackson, Handb. Conif. 40. 1923, 1931; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 279. 1931; Marshall, Trees Trinidad & Tobago 94. 1934, in part;[1] Parlatore in DC. Prodr. 16(2): 509. 1868, in part; Grisebach, Fl. Br. West-Ind. Isl. 504. 1861; Van Tieghem in Bull. Soc. Bot. France 38: 169. 1891; Duss in Ann. Mus. Colon. Marseille 3: 608. 1897.

Podocarpus antillarum R. Br. ex Mirbel in Mem. Mus. Hist. Nat. Paris 13: 76. 1825 (nomen).

Taxus (?) *lancifolia* Wikström in Kongl. Vetensk. Acad. Handl. 76. 1827.

Nageia coriacea O. Kuntze, Rev. Gen. 2: 800. 1891, in part; Britton & Wilson in N. Y. Acad. Sci. 6: 326. 1926.

Podocarpus salicifolia Klotzsch & Karsten ex Endl. Syn. Conif. 209. 1847 (nomen dubium)[2]; Williams & Williams, Useful & Ornamental Plants of Trinidad & Tobago, ed. 3, 11. 1929.[1]

A tree up to 20 m. tall, spreading, with divaricate branching. Bud scales at tips of vegetative shoots long acuminate, arising from a broad base, sometimes becoming foliaceous. Leaves crowded, spreading, straight to sub-falcate, coriaceous, lanceolate, gradually long acuminate toward the tip, acute, narrowing at base to a short petiole, 10–12 cm. long, about 10–11 mm. wide (larger in saplings and up to 22 cm. long and 17 mm. wide on lower sprout branches); midrib almost unnoticeable above or with a shallow groove, fairly broad and prominent beneath. Upper hypoderm continuous, rarely doubled except at margin and midrib, reinforced by rare larger fibers; epidermal cells 55–119 microns long and 18–33 microns wide. Pollen cones arising from buds axillary to leaves of previous year, solitary, sessile, cylindrical, surrounded at base by several large broad obtuse scales with the lowermost scales acutate, becoming 3–4 cm. long and 6 mm. wide. Microsporophylls with obtuse apiculus sparingly lacerulate. Seed cones solitary, axillary on short peduncles up to 7 mm. long; receptacle red, fleshy, 6–7 mm. long of 2–3 scales free at fleshy acute tips bearing solitary ovules. Seeds broadly ovoid or ellipsoid, up to 9 mm. long, 6–7 mm. wide, with distinct obtuse crests at apex and a slight ridge at back, with stony layer about 1 mm. thick.

DISTRIBUTION: Humid forests on hills and in wooded valleys of Caribbean islands from Puerto Rico eastward and southward to Trinidad.

[1] It is uncertain as to whether their reference to *P. coriaceus* L. C. Rich. applies here or to the *P. trinitensis* n. sp.

[2] Name applies to a Karsten specimen from unspecified locality in Colombia, and may represent another species rather than the Caribbean plant.

SPECIMENS EXAMINED:

PORTO RICO: Rio de Maricao, *Britton, Stevens & Hess 2462* (†F, GH, †Mo, NY, US),* *Britton, Stevens & Hess 2598* (NY, US), *Sintenis 291* (†F, GH, †Mo, NY, US), *Velez* in 1928 (NY), *F. H. Sargent 509* (†US); Cerro Gordo, San Germain, *Velez 1102* (†NY); El Ynque, *Horn 306* (†NY), *F. H. Sargent 288* (†US); detailed location unknown, *Aboy* in 1933 (†UC-2 sheets).

MONTSERRAT: Chaner's Mt., *Shafer 611* (†F, NY, US).

GUADELOUPE: *Duss 2397* (†F, GH, †Mo, †NY-2 sheets, US), *Questel 414* (US), *Stehle 885* (US), *Anon.* in 1824 (†GH).

DOMINICA: Morne Plat Pays, *Hodge & Hodge 1655* (†NY); Morne Nichols, *Hodge & Hodge 1909* (†NY); Morne Trois Pitoris, *Hodge 1378* (NY); Mt. Diablotin, *Lloyd 914* (†NY).

ST. KITTS: Mt. Misery, *Britton & Cowell 372* (†NY-2 sheets, US).

MARTINIQUE: *Duss 2097* (†F, GH, Mo, NY-2 sheets, Ph, US).

TOBAGO: Salem Charleston Trace, *Williams 11787* (†NY).

TRINIDAD: *Britton, Britton & Hazen 1007* (GH, †NY, US), *Anon.* in Sept. 1865 (†NY).

2. **Podocarpus Sellowii** Klotzsch in Endl. Syn. Conif. 209. 1847; Eichler in Fl. Brasil. 4(1): 431, pl. 113, fig. 1 and pl. 114. 1863; Carrière, Traité Conif. 2: 645. 1867; Parlatore in DC. Prodr. 16(2): 509. 1868; Van Tieghem in Bull. Soc. Bot. France 38: 169. 1891; Dallimore & Jackson, Handb. Conif. 55. 1923, 1931.

Podocarpus Selloi Pilger in Pflanzenreich IV. 5(Heft 18): 88. 1903, in Nat. Pflanzenfam. ed. 2, 13: 247. 1926; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 280. 1931.

An arborescent shrub up to 3 m. tall with branches and branchlets sub-opposite or 3–4 sub-verticillate. Buds, vegetative, with scales arising from an enlarged base, long acuminate, sometimes becoming foliaceous, up to 2 cm. long. New leaves moderately thin, becoming coriaceous, lanceolate, gradually narrowed above and below middle, acute, or sometimes tending to be caudate, the base merging very gradually with a distinct petiole, 6–10 cm. long, 7–12 mm. wide, those of vigorous shoots up to 15 cm. long and 16 mm. wide; with a slightly raised midrib above (a slight groove between two ridges) and a ridge below very pronounced near petiole and tending to disappear toward the tip. Hypoderm continuous above, vascular sclereids present above and below midvein, auxiliary sclereids absent; upper epidermal cells 24–66 microns long and 15–24 microns wide. Pollen cones narrowly cylindrical, about 3 cm. long, 2–2.5 mm. wide, solitary or fascicled, sub-sessile, surrounded at base by ovate-rotundate carinate scales; microsporophylls having triangular upturned, obtuse apiculus with lacerate margins. Female cones axillary and solitary on peduncles 5–12 mm. long; receptacle 5–8 mm. long, of 2 or 3 fused scales not equal in length, bearing a single ovule near the obtuse tip of the uppermost. Seeds spheroidally elongated, 7–9 mm. long, 5–7 mm. wide, with short blunt conical crest or crestless.

DISTRIBUTION: Southern Brazil.

SPECIMENS EXAMINED:

BRAZIL: Rio de Janeiro: *Glaziou* in 1872 (NY). Paraná: Roça Nova. *Dusén 7502* (GH, NY, US); Alexandra, *Dusén 15479* (A), *Dusén 8094* (US); Porto

† This symbol preceding the letter representing the herbarium in which the specimen is located indicates that leaves from the specimen were studied in cross-section.

* The place of deposit of specimens is shown by the parenthetical letters as indicated in the first paper of this series.

de Lima, *Dusén 7074* (GH, †Mo), *Dusén 6982* (A, GH, Mo). Without specific locality: *Sellow* (ex Mus. Bot. Berlin) (ISOTYPE, F, GH, NY, UC-2 sheets); *Riedel* (ex Herb. St. Petersburg) (GH, †US); *Glaziou 211* (ex Herb. Paris) (GH, †NY, US).

2a. **Podocarpus Sellowii** var. **angustifolius** Pilger in Pflanzenreich IV. 5(Heft 18): 88. 1903; Dallimore & Jackson, Handb. Conif. 55. 1923, 1931.

Differs from the species in having smaller, stiffer, more crowded leaves, more shortly angustate, usually up to 6 cm. long, 5–9 mm. wide, lighter in color on lower surface, with midvein below sometimes more prominent, the upper less distinct or with a groove between two low ridges tending to disappear toward the tip. Pollen cones smaller, 1–2 cm. long, 2 mm. wide, with apiculus of microsporophylls small or suppressed. Seeds unknown.

DISTRIBUTION: Southern Brazil.

SPECIMENS EXAMINED:

BRAZIL: Rio de Janeiro: *Glaziou* in 1888 (F). Paraná: Murungava, *Dusén 16503* (US); Casa Ypiranga, *Dusén 15428* (A, GH-2 sheets, †Mo-2 sheets, NY). Without specific locality (position of this specimen doubtful) *Barreto 8493* (†F).

3. **Podocarpus Pittieri*** n. sp.

Podocarpus coriaceus Pilger in Pflanzenreich IV. 5(Heft 18): 87. 1903, in part; sensu Pittier in Man. Plantas Usuales Venez. 258. 1926, non L. C. Rich.; sensu Knuth in Fedde, Repert. Spec. Nov. Reg. Veg. Beih. 43: 95. 1926, non L. C. Rich.; sensu Schnee in Bol. Soc. Venezol. Cienc. Nat. 9: 187. 1944, non L. C. Rich.

Arbor ad 10 m. alta, trunco ad 40 cm. diametro; foliis in ramulis subconfertis; alabastris summis perulis longe acuminatis insignitis, 5–15 mm. longis (interdum ad 25 mm., tum foliaceis); foliis coriaceis, lineari-lanceolatis, falcatis, angustatis, laevibus compressis, costa supra vix manifesta (petioli regione exceptà), subtus elevata, 6–18 cm. longis, 7–16 mm. latis; strobilis masculis (*fide Schnee*) solitariis sessilibus basi squamulis nonnullis circumdatis, cylindricis, ad 4 cm. longis; strobilis femineis pedunculo gracili insidentibus, ad 12–24 mm. longis, receptaculo e squamis 2–3 coalescentibus demum incrassato-carnosis, 6–10 mm. longis, 5–7 mm. latis; seminibus late ovoideis, 8–12 mm. longis, 7–9 mm. latis, crista minima.

DISTRIBUTION: Coastal ranges of northern Venezuela in the dense high forests at 1400–2130 meters.

SPECIMENS EXAMINED:

VENEZUELA: Federal District: Altos de Galipan, Cerros del Avila, Boca de Tigre, altitude 1600 meters, *H. Pittier 8298* (TYPE in †Gray Herb. Harv. Univ., F, US); *Lasser 999* (†US); *Tamayo 1382* (US); *Williams 10633* (F); *Delgado 205* (F, US); *Steyermark 55098* (F, †Ill); Puerto la Cruz, *Jahn 7395* (US); *Whitford 50* (GH); upper cotiza near Caracas, *Pittier 7396* (†GH, US); on crest near Caracas, *Curran and Haman 1110* (GH, NY, US); east of El Junquito, *Steyermark 57035* (F, †Ill); prope Coloniam Tovar, *Fendler 1228* or *1288* (GH, †Mo, YU). Province unknown: *Williams 9929* (F).

Inasmuch as up to this time these specimens have been included under *P. coriaceus* the leaf anatomy has been studied for comparison with the

*Named in honor of Dr. Henri Pittier, botanist in the Ministry of Agriculture, Venezuela, who, through collecting, publishing and directing research, has greatly increased the knowledge of the floras of Venezuela and Costa Rica.

above species and striking differences observed. In *P. Pittieri* the lower hypoderm fibers are almost twice as large as the upper while in *P. coriaceus* these are scarcely larger than the upper. Scattered in the palisade and mesophyll are found auxiliary sclereids (Plate I, Fig. 2). These are of the type resembling in shape the cells of the tissues in which they are found but enlarged and having thickened laminated pitted walls and lacking cell contents.

4. **Podocarpus Reichei*** n. sp.

Podocarpus guatemalensis Reiche in Mexico Forestal 5: 77–78. 1927.

Podocarpus coriaceus Karsten in Ber. Deutsch Bot. Gesell. 11. 1897.

Arbor ad 20 m. alta, 6 cm. diametro, cortico griseo valde rimoso; perulis (alabastris vegetativis) longe attenuatis (Plate I, Fig. 1), rigidis erectisque, 4–10 mm. longis, apice tantum subreflexis; foliis crassis, coriaceis, lanceolatis, interdum falcatis acutisque, 7–12 cm. longis, 11–16 mm. latis, costa supra proeminente utrinque canaliculata margine subrevoluto; strobilis masculis solitariis vel geminatis, cylindricis ad 5 cm. longis; strobilis foemineis pedunculis 9–18 mm. longis fultis, bracteis sterilibus in receptacula confluentibus ovulum unicum vel duo obscure cristate proferentibus; receptaculo quam 12 mm. longiore, demum carnoso, sapido, rubescente, ultimo atro-brunneo; semine magno, ovoideo, obtuse cristato, grosse rugoso, ca. 15 mm. longo, 12–13 mm. crasso, in sicco 10–12 mm. tantum longo.

DISTRIBUTION: East central Mexico in mountains of Pueblo, Vera Cruz and San Louis Potosi at altitudes of 1000–3500 meters in mixed pine-hardwood-podocarpus forests on moist slopes.

SPECIMENS EXAMINED:

MEXICO: Puebla: Escarpment above Huauchinango, 6400 ft. *A. J. Sharp 441222* (TYPE in †Herb. Univ. Ill., Tenn); region of Huauchinango, *Reiche*, in 1927 (†US); *Gilly*, in 1943 (†Ill, Mex); *Sharp 45338* (†Ill, Tenn), *Sharp 45338a* (†Ill, Tenn), *Sharp 441227* (†Ill, Tenn). San Louis Potosi: Cerro Prieto west of Xilitla, *Sharp 46286* (†Ill, Tenn). Vera Cruz: below Atzalan, *Sharp 46150* (†Ill, Tenn). Cultivated: near Jalapa, *Rose & Hay 6192* (†US).

COSTA RICA: Calle de Guadelupe, *Orozco 324* (F).

The leaf cross-sections show a continuous upper hypoderm of small fibers, 14–18 microns in diameter, with the lower scarcely any larger. Auxiliary sclereids are absent in the palisade and mesophyll and only upper vascular sclereids are present. For such large leaves, this lack of supporting sclereids is notable. In fact, the amount of sclerotic tissue seems to bear no relation to the size of the leaves as the very small leaves of other species are often abundantly supplied. The upper epidermal cells are long and narrow, not over 16 microns wide, and the walls are not wavy. Pollination, according to Reiche, in April and May.

5. **Podocarpus Matudai** Lundell in Phytologia 1(6): 212. 1937.

A large tree, sometimes with trunk up to 1.5 m. or more in diameter. Terminal buds large with angustate-lanceolate, somewhat spreading scales.

* Named in honor of the late Prof. Karl Reiche, an eminent explorer in plant geography and an authority of the floras of Mexico and Chile. From 1911–1920 he was professor of botany at the National University of Mexico, during which time he published a number of carefully prepared treatises in botany and biology.

Leaves coriaceous, lanceolate, narrowly acute at apex, narrowed to a petiole below, with a somewhat rounded ridge above midvein, becoming less prominent toward apex and less prominent below, 4–9 cm. long, 10–15 mm. wide on mature reproductive branches (up to 16 cm. long and 19 mm. wide on vigorous shoots). Leaf cross-sections show scattered auxiliary sclereids in palisade and mesophyll and vascular sclereids both above and below bundle. Pollen cones sessile, cylindrical, arising from axillary buds of previous season's growth, becoming 3–3.5 cm. long, 4 mm. wide, surrounded by broad, carinate apiculate scales, shedding pollen in January or later. Microsporophylls with upturned obtuse apices with scarious, denticulate margins. Seed cones on short peduncles 4–6 mm. long, receptacle of a pair of fused thickened scales 4–6 mm. long, with short obtuse apices. Seed 8–10 mm. long, 7–8 mm. wide, with a blunt crest scarcely evident.

DISTRIBUTION: Fog forests in southern Mexico at 1250–2370 m.

SPECIMENS EXAMINED:

MEXICO: Chiapas: Mt. Pasitar, *Matuda 698* (type coll., †Mich, US), *Matuda*, January 1937 (†GH); Mt. Ovando, *Matuda 1847* (†Mich, †A), *Matuda 956*, July 1938, (A, †F, NY, US), *Matuda 698*, December 1936, (F); Triunfo, *Xolocotzi & Sharp 45978* (†Ill, Tenn).

5a. **Podocarpus Matudai** var. **macrocarpus** n. var.

A speciei forma typica differt seminibus valde majoribus ecristatis, receptaculo minore, 12–17 mm. pedunculato (Plate II, Fig. 1); seminibus epicarpio haud exsiccato subsphaericis ad 18 mm. longis, 14 mm. latis (Plate II, Fig. 2). Perulis formae typicae at brevioribus; strobilis masculis 4–5 cm. longis, in anthesi quam speciei fortasse longioribus.

DISTRIBUTION: In southern Mexico, State of Chiapas, and in adjacent mountain ranges of Guatemala. Altitude 200–2600 meters, moist slopes in cloud forests and below.

SPECIMENS EXAMINED:

MEXICO: Chiapas: Mt. Ovando, *Matuda 956*, April 1936 (TYPE in †Herb. Univ. Mich., †A), *Matuda 698*, August 1936 (†GH), *Matuda*, November 1939, (†F).

GUATEMALA: Dept. Huehuetenango: Sierra de los Cuchumatanes, Cerro Huitz, *Steyermark 48589* (†F), *Steyermark 48543* (†F); Cerro Canana, *Steyermark 49105* (†F); between Xoxlac and Nucapuxlac, *Steyermark 48921* (†F); between Cerro Chiblac and Finca San Rafael, *Steyermark 49472* (†F). Dept. Chiquimula: Cerro Brujo, *Steyermark 31091* (†F). Dept. El Progreso: between Finca San Miguel and summit of mountain, *Steyermark 43803* (†F). Dept. Guatemala: *Aguilar 613* (†F).

The pollen cones mature earlier than in the species, are 5–6 cm. long in August, probably shedding their pollen in autumn.

6. **Podocarpus Roraimae** Pilger in Notizbl. Bot. Gart. Berlin 5: 299. 1913; Ule in Bot. Jahrb. 52(Beibl. 115): 48. 1914; Knuth in Fedde, Repert. Spec. Nov. Reg. Veg. Beih. 43: 95. 1928; Gleason in Bull. Torrey Bot. Club 58: 315. 1931.

A tree 10–15 m. tall with dense foliage crowded on numerous branched branchlets. Terminal buds globose with outer scales acuminate-attenuate, becoming foliaceous from an enlarged base. Leaves oval or obovate to oblanceolate, shortly rotundate-angustate, at tip somewhat obtuse, gradually narrowed toward base into a short petiole, 1.5–3 cm. long, 4–7 mm. wide (those of vigorous lower branches and juvenile foliage shortly subapiculate, up to 6 cm. long and 8 mm. wide), shiny dark green above, dull

green beneath, with an indistinct ridge above the midvein, often replaced (especially toward tip) by two smaller ridges with a groove between. Leaf cross-sections show hypoderm continuous, reinforced by larger fibres; no auxiliary sclereids in palisade or mesophyll (Plate I, Fig. 3). Pollen cones unknown. Female peduncle 4–5 mm. long, receptacle 6 mm. long, 4 mm. wide. Seed elongated, 6 mm. long, 4 mm. wide, with ridge and minute crest.

DISTRIBUTION: Venezuela-Brazil border westward to Mt. Duida at 2000–3000 m.

SPECIMENS EXAMINED:

VENEZUELA: State of Bolivar: Mt. Roraima, *Ule 40* (type photograph GH, fragment †F); *Steyermark 58949* (F-2 sheets, †Ill); Mt. Duida, summit of Peak No. 7, *Tate 659* (NY, †US).

7. **Podocarpus Steyermarkii*** n. sp.

Arbor 7–12 m. alta; ramulis foliis confertis insignitis, alabastris summis squamis longe attenuatis 5–16 mm. longis (vel longioribus tum subfoliaceis); foliis coriaceis, lanceolatis, arcuatim patentibus, 4–8 cm. longis, 6–11 mm. latis, supra laete viridibus, per costam bene sulcatis, margine subrevolutis, subtus pallidioribus ad subargenteis, costa elevata; strobilis masculis ignotis; strobilis foemineis pedunculis crassis 7–10 mm. longis fultis, receptaculo 7–8 mm. longo; semine viridi subargenteo, grosse striato minuteque cristato.

DISTRIBUTION: Venezuela, southeastern part; seen at only one place along small stream near its source, 2100–2400 m. alt.

SPECIMENS EXAMINED:

VENEZUELA: State of Bolivar: upper slopes of Carrao-Tepui, *Steyermark 60876* (TYPE in Chicago Natural Hist. Museum, †Ill).

Cross-sections of the leaves show upper hypoderm continuous, the fibers large, 20–26 microns in diameter, and reinforced by additional scattered larger fibers; vascular sclereids very abundant above bundle, rare below; auxiliary sclereids lacking in palisade and mesophyll (Plate III, Fig. 3).

8. **Podocarpus magnifolius** n. sp.

Arbor ad 20 m. vel ultra alta, trunco erecto ramis suberectis patentibus; ramulis robustis, alabastris summis magnis, squamis crassis breviter acuminatis; foliis coriaceis erecto-adscendentibus, supra saturate viridibus, late lanceolatis, minoribus interdum oblanceolatis, subtus pallidioribus in ramulis maturis 5–9 cm. longis, 12–17 mm. diametro, interdum ad 17 cm. longis, 24 mm. latis, acutis vel breviter acuminatis; foliis minimis interdum obtusis; folio supra per costam eprofunde canaliculato, canaliculo interdum utrinque marginato, subtus costa obtusa, lamina in petiolum alatum ad 3–5 cm. longo confluente; strobilis masculis sessilibus, solitariis axillaribus (immaturis tantum visis) squamis plurimis basi insignitis, sporophyllis arctius imbricatis, apice bene evolutis, acuti-obtusis, scariosis, denticulatis.

DISTRIBUTION: In southeastern Venezuela on southeast-facing slopes of Ptari-tepui at 1580–1600 m. altitude and in Bolivia at 850–950 m. altitude; should appear in nearby Brazil.

* Named for Julian A. Steyermark, of the Chicago Museum of Natural History, in recognition of his contributions to the knowledge of plants of Central and South America, especially through his collections from hitherto unknown regions.

SPECIMENS EXAMINED:

VENEZUELA: State of Bolivar: on Ptari-tepui, *Steyermark 59989* (TYPE in Chic. Nat. Hist. Mus., †Ill); *Steyermark 60035* (sapling) (†F, Ill).

BOLIVIA: Dept. La Paz: Prov. Larecaja: Copacabana, *Krukoff 11273* (†A, NY, US). CULTIVATED: Brazil, Jardim Botanico, San Paulo, *Hoehne 29363* (NY).

Leaf-cross-sections show continuous upper hypoderm, doubled, fibers large, 18–26 microns in diameter; vascular sclereids very abundant both above and below bundle; auxiliary sclereids occasionally present in mesophyll but absent in palisade; epidermal cells 50–70 microns long.

9. **Podocarpus Rusbyi*** n. sp.

Podocarpus salicifolius sensu Britton in Bull. Torr. Bot. Club 16: 13. 1889, non Kl. & Karst.

Arbor vel frutex foliis confertis, perulis in alabastris summis longe attenuatis ad 16 mm. longis; foliis coriaceis, lanceolatis, acute acuminatis, 2–3.5 cm. longis, 4–7 mm. latis, per costam bene canaliculatis, ad marginem deminutis, costa subtus bene manifesta ad petiolum carinata; strobilis masculis ignotis; strobilis foemineis pedunculo 3–4 mm. longo fultis, receptaculo 6–7 mm. longo, bracteis in apice divaricatis interdum 2-carpiis; semine ad 7 mm. longe per longitudinem costulato, obtuse cristato (Plate IV, Fig. 1).

DISTRIBUTION: Only in Bolivia, altitude 10,000 ft.

SPECIMENS EXAMINED:

BOLIVIA: Mapiri, *Rusby 2463*, April 1886, (TYPE in †Herb. N. Y. Bot. Gard., GH, Ill, Mich, †Ph, †UC, US-2 sheets); Cocopunco, *Tate 369* (†NY).

Cross sections of the leaves show continuous upper hypoderm of small fibers, 12–18 microns in diameter; vascular sclereids abundant both above and below bundle on either side of resin canal; auxiliary sclereids few in palisade and mesophyll. Upper epidermal cells 11–22 microns long.

10. **Podocarpus tepuiensis** n. sp.

Arbor 10–15 m. alta trunco ad 30 cm. diametro; alabastris parvis, perulis late triangularibus, apiculatis, 2 mm. longis; foliis dense confertis late lanceolatis, acutis, 1.5–2 cm. longis, 4–5 mm. latis, per costam canaliculatis, costa subtus ad medium inferum proeminente, laminae margine subrevoluto, supra lucidis saturateque viridibus, subtus viridibus, basi cuneatis, sessilibus vel brevissime pedunculatis; strobilis masculis solitariis, axillaribus, sessilibus ad 1 cm. longis, 1.5 mm. crassis; microsporophyllis apice scariosis deflexis; seminibus 7 mm. longis, 4 mm. crassis, cristato-rostratis.

DISTRIBUTION: On forested south-facing sandstone slopes on Mt. Ptari-tepui, 1700–1800 m. altitude, in Venezuela.

SPECIMENS EXAMINED:

VENEZUELA: State of Bolivar: Ptari-tepui, *Steyermark 59716* (TYPE in Chicago Nat. Hist. Mus., †Ill), *Steyermark 59715* (F, †Ill).

* Named for Henry H. Rusby who contributed the type specimen of this species. He was formerly Professor of Pharmacognosy at Columbia University, N. Y., and he collected widely in South America, both naming and describing many species.

Cross sections of leaves show continuous upper hypoderm, sometimes doubled, fibers up to 25 microns in diameter; lower hypoderm twice as large as upper; auxiliary and vascular sclereids both absent.

11. **Podocarpus Purdieanus** Hooker, Icon. Pl. pl. 624. 1844; Endlicher Syn. Conif. 210. 1847; Lindley & Gordon in Jour. Hort. Soc. London, 5: 223. 1850; Carrière in Jacques & Herincq, Man. des Pl. 4: 369. 1857, Traité Conif. 446. 1855, ed. 2, 647. 1867; Gordon, Pinetum 281. 1858; Parlatore in DC. Prodr. 16(2): 510. 1868; Grisebach, Fl. Brit. West-Ind. Isl. 504. 1861, in part; Fawcett, Econ. Pl. Jamaica 64–65. 1891; Van Tieghem in Bull. Soc. Bot. France 38: 169. 1891; Fawcett, Pl. Jamaica 49. 1893; Dallimore & Jackson, Handb. Conif. 55. 1923, 1931; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 280. 1931.
Podocarpus jamaicensis Hort. in Gordon, Pinetum 281. 1858.
Podocarpus mucronata Hort. in Carrière, Traité Conif. 446. 1855.

A tree up to 40 m. high or higher with trunk diameter up to 1 m. with spreading branches. Twigs moderately short without numerous branchlets. Terminal buds with scales thick below, becoming thin and scarious at margins and with a spine-like apiculus, leaving transverse rhomboidal scars on stem. Leaves subspatulate-lanceolate, coriaceous, shiny above, paler bright green beneath, with a slight groove between ridges or a ridge above (in lower half of leaf) with margin sometimes tending to be revolute and with midrib raised on lower side only near petiole. Leaves of reproductive branches usually 4–9 cm. long, 8–14 mm. wide, with short spine at apex (those of vigorous branches and young plants up to 14 cm. long and 17 mm. wide), sometimes slightly falcate, narrowly acute at apex but sometimes without spine. Leaf cross-sections show continuous upper hypoderm, rarely doubled; vascular sclereids present or absent; auxiliary sclereids absent. Pollen cones solitary, axillary, cylindrical, up to about 15 mm. or more in length. Female cones axillary, on peduncles 2–4 mm. long with receptacle of 2 fused thickened scales nearly equal in length and with carinate spreading triangular tips. Seed oblong, 8 mm. long, 5 mm. wide, with a conical obtuse crest.

DISTRIBUTION: Jamaica, mountains of central and eastern regions at elevations of 2400–3500 ft.

SPECIMENS EXAMINED:

JAMAICA: near Troy, *Harris 8716* (†F, NY, US), *Harris 8828* (†F, NY, US); Mt. Diablo, *Harris 8989* (†F, NY), *Buchholz* in 1946 (Ill); Holly Mount, *Harris 6629* (F, †NY, Ph); Union Hill near Moneague, *Britton & Hollick 2798* (†F, †NY, US); Albert Town, *Anon.* in 1943 (†Ill); locality not given, *Purdie* (†F, †UC).

12. **Podocarpus trinitensis** n. sp.
Podocarpus coriaceus sensu Marshall, Trees Trinidad & Tobago 94. 1934, in part, non. L. C. Rich.

Arbor parva; perulis quam 3 mm. brevioribus, triangularibus attenuatis apiculatisque, alabastris summis globosis; foliis coriaceis lanceolatis vel oblanceolatis apice acutis vel late acutis, interdum obtusis (tum oblanceolatis), ad basem in petiolum alatum coarctatis, supra lucidis, costa manifesta, marginibus leviter subrevolutis subtus laevibus canaliculatis, 3–6 cm. longis, 7–10 mm. latis; strobilis masculis ignotis; strobilis foemineis axillaribus pedunculis ca. 7–8 mm. longis; semine (sicco) 7–8 mm. longo ecristato vel perobscure cristato (Plate IV, Fig. 2), costulis nullis; receptaculo semen longitudine aequante.

DISTRIBUTION: Forests on mountain slopes in Trinidad.

SPECIMENS EXAMINED:

TRINIDAD, B. W. I.: Valencia road, *Broadway 7151,* May 1929, with seeds (TYPE in †Mo. Bot. Gard. Herb., †US); Trurure river forests, *Broadway 7702* (†US); Mt. Tucuche, *Britton, Hazen & Mendelson 1246* (†GH, NY, US).

CULTIVATED: Trinidad, Bot. gardens, *Broadway 7277* (†F, †Mo, US).

Leaf cross-sections show continuous upper hypoderm; vascular sclereids always present above bundle, sometimes below; auxiliary sclereids absent in palisade and mesophyll.

If this entity is the tree described by Marshall under *P. coriaceus,* as seems likely, one may add the following to the description: fairly large tree with trunk often fluted up to 80 cm. in diameter with dark grayish brown bark, fairly smooth, the inner bark pinkish red, fading to almost white. Pollen cones slender, up to 2 cm. long. His description of pollen cones (slender up to ¾ in.) is too small. However, there is evidence that *P. coriaceus* actually occurs on Trinidad; if so, only a part of Marshall's description may apply to this species and to the one occurring on Tobago Island.

13. **Podocarpus guatemalensis** Standley in Proc. Biol. Soc. Wash. 37: 49–50. 1924; Pilger in Nat. Pflanzenfam. ed. 2, 13: 247, 1926.

A tree up to 20 m. high with trunk up to 70 cm. in diameter with smooth reddish brown bark, upright habit of growth with spreading crown. Vegetative buds spherical or ovoid with broad ovate bud scales apiculate or obtuse, scarious at margins or not so. Leaves lanceolate, with a distinct ridge at midvein, flat or depressed below midvein, cuneately narrowed near base, angustate toward apex, sometimes falcate, those of lower branches or saplings up to 14 cm. long, 10–12 mm. wide, those of mature reproductive branches usually up to 10 cm. long and less than 10 mm. wide. Cross-sections of leaves show the upper hypoderm to be interrupted and no auxiliary sclereids in palisade or mesophyll; leaves of the species show no vascular sclereids. Pollen cones cylindrical, arising from special buds axillary to leaves or scales of previous year's growth. Seed cones axillary to leaves (formed in year of pollination). Seed on short peduncles up to 4–5 mm. long, receptacles up to 7 mm. long; seeds ellipsoidal up to 8 mm. long (dry) with small conical crests.

The above description is based largely upon mature specimens included under the variety *pinetorum.* There may be some question as to the identity of the plants named *P. guatemalensis* by Standley and *P. pinetorum* by Bartlett. Standley's type specimen is admittedly that of a sapling which may be from seeds derived from near-by British Honduras, where the upland variety is abundant. We find the leaves differing in size as sapling and mature foliage in related species of *Podocarpus* may differ. The vegetative buds of *P. guatemalensis* are ovoid, while those of var. *pinetorum* are usually more spherical. The bud scales of *P. guatemalensis* are ovate and apiculate while those of the var. *pinetorum* are obtuse, broadly acute, sometimes somewhat apiculate or with only a few of the outer scales apiculate (Plate V, Figs. 1 and 2). In leaf anatomy we have found that the leaves of *P. guatemalensis* do not possess vascular

sclereids while those of the upland variety have this character. However, the leaves of the type specimen of *P. guatemalensis* may represent juvenile conditions or leaves of intermediate condition, which might be expected to develop the characteristics of the variety when fully mature. These two entities must evidently be merged in some way and, following the rules of priority, the British Honduras plants become a variety under *P. guatemalensis*.

DISTRIBUTION: In low land at Puerto Barrios, in Guatemala.

SPECIMEN EXAMINED:

GUATEMALA: Dept. Izabal: Puerto Barrios, *Standley 25090* (†US, †GH).

13a. **Podocarpus guatemalensis** var. **pinetorum** (Bart.) n. comb.

Podocarpus pinetorum Bartlett in Publ. Carnegie Inst. Wash. **461**: 21. 1935.

Differs from species in having much larger terminal buds with broader, thicker scales. Leaves shorter, narrower, and thicker. Cross-sections of the leaves consistently show vascular sclereids above bundle (Plate VI, Fig. 1). Upper epidermal cells 22–66 microns long, 11–22 microns wide.

DISTRIBUTION: River valleys in coastal ranges of British Honduras.

SPECIMENS EXAMINED:

BRITISH HONDURAS: El Cayo District: Mt. Pine Ridge, *Bartlett 13109* (A, type coll. †Mich, NY, US). Belize District: *Gentle 3452* (A, †F, NY, Mich). Toledo District: Monkey River, *Gentle 3967* (A, †NY, US). Southern District: Stann Creek Valley, *Stocker 18* (†F), *Burns 21* (†F, US); *Gentle 3159* (A, DS, †Mich, NY); *Schipp 969* (A, F, GH, Mich, †Mo, NY, UC). District not given: Temash River, *Kinloch 49* (†F, NY, US), near Middlesex, *Schipp 441* (A, F, CAS, GH, Mich, Mo, NY, UC), *Schipp 444* (A, †F, GH, Mich, Mo, NY, UC); *Schipp* in 1929 (F, †US).

13b. **Podocarpus guatemalensis** var. **Allenii** (Standley) n. comb.

Podocarpus Allenii Standley in Woodson & Schery, Ann. Mo. Bot. Gard. **28**: 409. 1941.

Trees 33–36 m. Leaves smaller than species or var. *pinetorum*, 4.2–6.7 cm. long, 7.5–10 mm. wide on mature trees (juvenile foliage 9.5 cm. long, 12–13 mm. wide). Leaf cross sections show vascular sclereids above and below bundle. Upper epidermal cells 11–31 microns long, 8.5–15 microns wide.

DISTRIBUTION: Cerro Campana in Panama; seedlings abundant in cut-over forests.

SPECIMENS EXAMINED:

PANAMA: Prov. Panama: Cerro Campana, *Allen 2437* (†F, Mo), *Allen 2424* (†F seedling). Prov. Cocle: La Mesa, *Allen 2298* (†F); near Bocas del Toro, *Cox* in 1933 (†US).

COSTA RICA: South of Cartago, *Chrysler & Roever* in 1940 (†NJU seedling).

14. **Podocarpus Urbanii** Pilger in Pflanzenreich IV. 5 (Heft 18): 89. 1903; Pilger in Nat. Pflanzenfam. ed. 2, **13**: 247. 1926; Dallimore & Jackson, Handb. Conif. 57. 1923, 1931; Florin in Svenska Vet.-Akad. Handl. ser. 3, **10**(1): 280. 1931.

Podocarpus coriacea Hook. in Lond. Jour. Bot. **1**: 656, pl. 9. 1842, non Rich.; Endlicher, Syn. Conif. 210. 1847, in part; Grisebach, Fl. Brit. West-Ind. Isl. 504. 1861, in part; Parlatore in DC. Prodr. **16**(2): 509. 1868, in part.

Podocarpus Yacca G. Don in Lond. Hort. Brit. ed. 2, 388. 1832 (nomen), non Don ex Sweet Hort. Brit. ed. 3, 622. 1839.

A small tree seldom more than 10 m. high, with short thickly leafy branchlets. Terminal buds globose with many thin keeled broad obtuse

scales, the outer sometimes minutely apiculate. Leaves stiffly coriaceous, straight, narrowly lanceolate, pungent-apiculate but sometimes only acute or becoming obtuse, gradually narrowed below to a subsessile base, 2.5–3.5 cm. long, 4–7 mm. wide. Midvein slightly raised above in lower portion of leaf, marked by a non-stomatiferous stripe, slightly depressed, flat or sometimes raised in stripe-like wrinkles, below. Leaves of seedlings or small shaded branches may exceed 5 cm. Cross-sections of leaves show continuous upper hypoderm, fibers 18 microns in diameter, vascular sclereids occasionally present above; auxiliary sclereids absent. Pollen cones solitary, axillary to leaves of a previous year, sessile, surrounded by numerous thin scarious scales, the outer smaller, carinate and minutely apiculate, cylindrical, 12–15 mm. long, 4 mm. wide. Microsporophylls with upturned apiculus well developed, obtuse and scarious at margins. Female cones of a pair of fused thickened scales forming a receptacle 7 mm. long, the divergent tips triangular, acute, and sharply keeled on peduncles 2–4 mm. long. Seeds ovoid 7 mm. long, 4 mm. wide with a 1 mm. long conical obtuse crest.

DISTRIBUTION: Jamaica, Blue Mountains between 4500 and 7300 ft.

SPECIMENS EXAMINED:

JAMAICA: Cinchona, *Harris 7798* (†F, NY, Ph), *Harris 11117* (†F, NY, US), *Harris 8305* (†F, NY), *Harris 8490* (NY), *Harris 8489* (NY), *Harris 9199* (A), *Harris & Lawrence C15253* (†US), *Britton 130* (NY), *Hart 1086* (US), *Buchholz* in 1946 (Ill); Blue Mountain, *Bancroft & Miller 17* (US), *Hart s.n.* (†F), *Hunnewell & Griscom 14107* (GH), *Chrysler 2038* (NJU, Penn), *Sargent* in 1885 (†A), *Maxon 1440* (US), *Alexander* (?) *274* in 1850 (†NY), *Anon.* in 1943 (Ill); Morce's Gap, *Rehder* in 1903 (A, NY), *Buchholz* in 1946 (Ill), *Purdie* in 1844 (NY), *Alexander* in 1850 (NY); Mossman's Peak, *Maxon 9784* (GH, US).

15. **Podocarpus pendulifolius** n. sp.

Arbor parva 6–7 m. alta (fide Steyermark: monoica); ramulis crassis, alabastris magnis globulosis; perulis late ovatis, saepius obtusis scariosisque, carinatis; foliis dependentibus, percoriaceis pallide viridibus, lucidissimis, arctius lanceolatis, falcatis, in ramulis robustis sublinearibus, acuminatis, applanatis vel bisulcatis; laminae margine laevi, incrassato haud revoluto; strobilis masculis ex alabastris lateralibus sessilibus, perulis numerosis late ovatis, cylindricis ad 2 cm. vel ultra longis, 6–7 mm. crassis; microsporophyllis apice bene dilatatis, obtusis, scariosis denticulatis; strobilis foemineis axillaribus pedunculis 7–10 mm. longis fultis; receptaculo glauco semen longitudine aequante; semine viridi glauco, globoso vel subturbinato, crista minima obtusa.

DISTRIBUTION: In dwarfed forests on slopes in Western Venezuela, altitude 1800–3000 meters.

SPECIMENS EXAMINED:

VENEZUELA: State of Tachira: dwarfed forest on slopes below Páramo de la Negra above La Grita, *J. A. Steyermark 57115*, July 7, 1944 (TYPE in †Herb. Univ. Ill., F), *Steyermark 57113* (F, †Ill), *Steyermark 57114* (F, †Ill). State of Merida: between La Cumbre, San Jose and Mucutuy, *Steyermark 56238* (†F).

Leaf cross-sections show upper hypoderm continuous, often doubled and reinforced by larger fibers; vascular sclereids present above and below bundle; auxiliary sclereids rare in palisade but abundant in mesophyll. The margin of the leaf is much swollen or thickened (Plate VI, Fig. 2).

16. **Podocarpus oleifolius** D. Don in Lambert, Pinus 2: 20. 1824, ed. 2, 2: 121. 1828; Endlicher, Syn. Conif. 209. 1847; Carrière, Traité Conif. 645. 1867; Parlatore in DC. Prodr. 16(2): 510. 1868; Pilger in Pflanzenreich IV. 5 (Heft 18): 87. 1903; Weberbauer in Veg. der Erde 12: 74. 1911; Herzog in Veg. der Erde 15: 161. 1923; Dallimore & Jackson, Handb. Conif. 54. 1923, 1931; Florin in Svenska Vet.-Akad. Handl. ser. 3. 10(1): 280. 1931; Rimbach, Trop. Woods 31: 3. 1932, Flora (Quito, Ecuador) 2: 119. 1942; Macbride, Flora of Peru, 1 (Field Mus. Nat. Hist. Publ. 351, Bot. Ser. 13): 84. 1936; Standley, Flora Costa Rica, Field Mus. Nat. Hist. Publ. 391, Bot. Ser. 18: 64. 1937.

A tree up to 20 m. high with yellowish brown bark, the branches and leaves crowded. Vegetative buds globose, the bud scales rounded or broadly ovate, obtuse and scarious margined (Plate VI, Fig. 3). Leaves stiffly coriaceous, lanceolate-angustate, gradually narrowed toward tip, narrowly acute and subsessile at base, 2.5–8 cm. long, 5–12 mm. wide, (those of sprouts, saplings or vigorous shoots up to 15 cm. long and 20 mm. wide), with a well-marked narrow groove above the midvein, broad but not very prominent underneath. Cross-sections of leaves show continuous upper hypoderm, reinforced by larger fibers, lower hypoderm fibers larger than upper; vascular sclereids usually present, often abundant; auxiliary sclereids usually present, often very abundant in both palisade and mesophyll. Pollen cones solitary, axillary, 3 cm. long, 3 mm. wide (expanded), arising from sessile buds of previous year's growth surrounded by thick rounded carinate scales. Microsporophylls tipped with upturned rotundate apiculus. Female cones solitary, axillary, on peduncles 5–10 mm. long, receptacle of 2 fused fleshy scales free at tip, 6–9 mm. long. Seed globose-ovoid with a suppressed crest, 7–8 mm. long.

DISTRIBUTION: From southern Mexico (Chiapas and Oaxaca) to northern Peru and Bolivia, at elevations 2000–2800 m. with a variety extending eastward into Venezuela.

SPECIMENS EXAMINED:

MEXICO: Oaxaca: "Petlapa" (Petalpa) *Liebmann 14822* (†F); near Reforma, *Xolocotzi & Sharp 46236* (†Ill, Tenn).

GUATEMALA: Zacapa: *Steyermark 42573* (†F), *Steyermark 42801* (†F-2 sheets), *Steyermark 43266* (†F); Sierra de Minas, *Sharp 45248* (†Ill, Tenn).

EL SALVADOR: Chalatenango, Los Esmiles, *Tucker 1034* (†UC).

COSTA RICA: Prov. Alajuela: Poas, *Smith 6856* (†F, GH, Mo, NY, US-2 sheets). Prov. San Jose: *Standley 42142* (US); *Standley 42993* (US); La Palma de San Ramon, *Brenes 3840* (F), *Brenes 6230* (F), *Brenes 5653* (†F), *Brenes 6378* (†F), *Quiros 272* (F); Cerro Jucosal, *Stork 1120* (F, Mich); Cartago, *Standley & Torres 51768* (US), *Standley 33914* (F, US); south of Cartago, *Stork 401* (†US), *Stork 366* (†US), *Chrysler & Roever 5440* (†NJU), *Chrysler & Roever 5454* (NJU); Volcan de la Vieja, *Brenes 15554* (F); Poas, *Standley 34640* (US, F), *Greenman & Greenman 5375* (†Mo), *Tonduz 10744* (US), *Pittier 2052* (GH, †US); El Copey, *Tonduz 11717* (US-2 sheets), *Stork 1541* (F), *Stork 1560* (F, Mich).

COLOMBIA: Santander: Cordillera Oriental, *Cuatrecasas, Schultes & Smith 12429* (†US). Santa Marta: *Espina & Giacometo A172* (†F, NY, US-2 sheets); Comisiaria del Putumayo, *Cuatrecasas 11840* (†US).

ECUADOR: Huigra, *Rose & Rose 23841* (GH, NY, †US); Prov. Azuay, *Steyermark 52605* (F, †Ill), *Steyermark 53348* (F, †Ill), *Steyermark 53431* (F, †Ill); El Oro: *Steyermark 53906* (F, †Ill); Loja: *Steyermark 54781* (F, †Ill); Corazon: *Andre 3930* (†NY).

PERU: Pillao, *Ruiz & Pavon* in 1778–1788 (ex Herb. Horti Bot. Matritensis) (†F); *Pavon* ex Berlin Herb. (photo 11576) (F, GH); Tatanara, *Lechler 2574* (ex Berlin) (F); Dept. Cajamarca: Cutervo, *Stork & Horton 10138* (†F, UC); Dept. San Martin: *Siebert 2084* (†Ill, US); *Weberbauer 4090* (ex Berlin Herb) (F).

16a. **Podocarpus oleifolius** var. **macrostachyus** (Parl.) n. comb.

Podocarpus macrostachyus Parlatore in DC. Prodr. 16(2): 510. 1868; Pilger in Pflanzenreich IV. 5 (Heft 18): 87. 1903; Pilger in Nat. Pflanzenfam. ed. 2, 13: 247. 1926; Dallimore & Jackson, Handb. Conif. 50. 1923, 1931; Pittier in Bol. Cient. Tecn. Mus. Com. Venezuela 1: 9. 1927; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 279. 1931; Schnee in Bol. Soc. Venezol. Cienc. Nat. 9: 185, fig. 4. 1944.

A tree up to 15 m. tall with leaves crowded on much branched twigs. Terminal buds spherical, scales thick, ovate, obtuse with scarious margins. Leaves crowded, spreading, somewhat shiny, dark green above, paler dull green beneath, very stiffly coriaceous, elliptical, short oblanceolate, obtuse, gradually narrowed to a short petiole, 2–5 cm. long, 7–12 mm. wide, with a distinct groove above the midvein, a ridge beneath. Pollen cones on peduncles 3–5 mm. long, arising from buds in the axils of leaves of previous year, cylindrical 2.5–3 cm. long, about 3–4 mm. in diameter, with many thick obtuse carinate scales at base of cone. Microsporophylls with obtuse upturned scarious apiculus. Female cones axillary on peduncles about 5 mm. long; receptacle fleshy, about 11 mm. long, of 2 scales free at obtuse tip. Ovules 1–2. Seeds ovoid, 10–12 mm. long, 5–6 mm. wide, distinctly crested at apex, the outer seed coat coriaceous.

This tree was originally described by Parlatore as from Colombia, whereas the first specimen he cited, *Fendler 1287* (technically the type) was actually collected in Venezuela near Colonia Tovar (now Tovar in Aragua, not Tovar in Merida of western Venezuela). Pilger repeats this error in citing Merida (western Venezuela) for the Fendler collection though he lists the *Moritz 1677* collection from Colonia Tovar. We have not seen the *Funk & Schlimm 16316* specimen from Merida, but a more recent one, collected by Steyermark, comes from this region. Nevertheless the type locality is in the coastal mountains north of Caracas. This variety occurs also through northern Colombia to Panama, but another variety of *P. oleifolius* is also found there with longer leaves. In Costa Rica *P. oleifolius* var. *costaricensis* has more pointed leaves, acute, with smaller seeds, but the pollen cones are similarly peduncled as in this variety.

DISTRIBUTION: Among dwarfed trees and shrubs at 1850–3050 meters altitude in Venezuela and Colombia.

SPECIMENS EXAMINED:

VENEZUELA: Federal District: El Junquito, *Steyermark 56968* (†F, Ill), *Steyermark 56967* (F, †Ill), *Schnee 32* (†Ill, Ven). Aragua District: Coloniam Tovar, *Fendler 1287* (ISOTYPE, GH, Mo, †NY, †Ph), *Moritz 1677* (†F, GH), *Pittier 9989* (US). State of Merida: Paramo above San Isdro Alto, *Steyermark 56552* (F, †Ill). State of Tachira: Paramo de la Negra above La Grita, *Steyermark 57085* (†F, Ill).

COLOMBIA: Dept. Antioquia: San Antonia, *Daniels 462* (†US). Province not given: Murillo, *Dawe 760* (NY, †US), *Purdie* (ex Bentham Herb.) (†GH, NY); *Triana 2* (ex Herb. Nat. Col.) (F, GH, NY, US).

16b. **Podocarpus oleifolius** var. **costaricensis** nov. var.

Podocarpus macrostachyus Pilger in Pflanzenreich IV. 5 (Heft 18): 87. 1903, in part.

Arbores inter *P. oleifolium* atque *P. oleifolium* var. *macrostachyum*

medium tenentes; perulis alabastrorum summorum, illis specierum supra laudatarum persimilibus; foliis saepius ad *P. oleifolium* var. *macrostachyum* accedentibus at magnis acutis; strobilis masculis pedunculo 3–6 mm. praeditis ut in *P. oleifolio* var. *macrostachyo*, at seminibus minoribus *P. oleifolii* mentientibus.

DISTRIBUTION: In Costa Rica, 1700–2800 m. on Volcan Poas.

SPECIMENS EXAMINED:

COSTA RICA: Dept. Alajuela: Volcan Poas, Potiero del Alto, *H. Pittier 822* (TYPE in †U.S. Nat. Herb.), *Pittier & Durand 363* (†US), *Valerio 1627* (F), *Valerio 1628* (†F), *Cooper 10322* (†US); *Stork 2519* (F), *Jimenez 1008* (†US).

PANAMA: *Sutton Hayes 749* (†NY).

16c. **Podocarpus oleifolius** var. **trujillensis** nov. var.

Varietas medium inter *P. oleifolium* atque *P. oleifolium* var. *macrostachyum* tenens, perulis in alabastris summis gracilioribus magisque carinatis; foliis per costam canaliculatis, saepius apice quam in speciebus laudatis latioribus, quam *P. oleifolii* magis obtusis, *P. oleifolii* var. *macrostachyi* longioribus; strobilis masculis ignotis; seminibus ad *P. oleifolii* var. *macrostachyi* accedentibus, pedunculo 10–18 mm. longo, receptaculo squamis carnosis, bracteis semina alte amplectentibus donato, 11–12 mm. longo.

DISTRIBUTION: Venezuela in states of Trujillo, Merida and Lara at 2300–3200 m. in cloud forests.

SPECIMENS EXAMINED:

VENEZUELA: State of Trujillo: *Steyermark 55335* (type in Herb. Chicago Nat. Hist. Mus., †Ill); Merida: *Gehriger 469* (A, F, NY, PH, †US, Ven), above Tabay, *Steyermark 56587* (F, †Ill); Lara: *Steyermark 55222* (F, †Ill).

17. **Podocarpus glomeratus** D. Don in Lambert, Pinus 2: 21. 1824, ed. 2, 2: 121. 1828; Gordon, Pinetum 337. 1875; Parlatore in DC. Prodr. 16(2): 513. 1868; Pilger in Pflanzenreich IV. 5(Heft 18): 86. 1903; Pilger in Nat. Pflanzenfam. ed. 2, 13: 247. 1926, in part; Dallimore & Jackson, Handb. Conif. 46. 1923, 1931, in part; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 279. 1931, in part.

Juniperus rigida Pavon *Mss.* ex Endlicher, Syn. Conif. 211. 1847.

Podocarpus rigida Klotzsch ex Endlicher, Syn. Conif. 211. 1847; Carrière, Traité Conif. ed. 2, 649. 1867.

A tree up to 12 m. high, but often dwarfed and shrubby, with dark brown bark and crowded foliage on numerous verticillate branches. Buds of vegetative branches sub-globose with scales ovate or broadly lanceolate-acuminate not over 7 mm. long, the outermost scales sometimes foliaceous. Leaves erect or sub-patent, stiffly coriaceous, straight, or sub-falcate, linear-lanceolate, light grayish green and shiny above, very glaucous beneath, angustate and narrowly acuminate at the tip ending in a stiff pungent prickle, narrowed at the base into a very short petiole, 2–5 cm. long, 2–4 mm. wide, with an open groove above the midvein and the margin turning down. Cross-sections of leaves show continuous hypoderm. Pollen cones fascicled, about 6 per cluster on slender peduncles 8–12 mm. long, with small awl-shaped 1–2 mm. long bracts, the cylindrical cones usually about 1.5 mm. in diameter, up to 6 mm. long, the sporophyll with deltoid, scarious denticulate apex. Ovulate cones sessile or on peduncles up to 4 mm. long, receptacle 5–6 mm. long, crestless or with very minute crest.

DISTRIBUTION: 2500–4000 meters on inland cordilleras of Peru and southern Ecuador.

SPECIMENS EXAMINED:

PERU: Huanuco: Panao, *Macbride 3630* (topotype, A, †F), *Woytkowski 113* (F). Junin: *Weberbauer 6586* (F, GH, US). Apurimac: Abancay, *Vargas 509* April 1938, (CAS, GH), *Vargas & Santander 509* August 1937, (†F), *West 3816* (GH, †UC), *Stork, Horton & Vargas 10620* (A, †UC). Cuzco: Torontoy, *Cook & Gilbert 835* (US), *Bingham 732* (US).

ECUADOR: Prov. Azuay: *Steyermark 53023* (F, Ill).

18. **Podocarpus Cardenasii*** n. sp.

Arbor ad 10 m. alta trunco ad 80 cm. diametro, habitu compacta ramulis ultimis saepius verticillatis; perulis in alabastris vegetativis lanceolatis, acuminato-apiculatis subreflexis, margine deorsum minute denticulatis; foliis divaricatim patentibus lineari-lanceolatis, pallide viridibus applanatis, subtus glaucescentibus, margine laminae subrevoluto, apice mucrone spinuloso pungente terminatis, deorsum in petiolum alatum confluentibus 1.5–3 cm. longis, 2–3 mm. latis; strobilis masculis fasciculatis, ad 6–8 in fasciculo, pedunculis gracilibus eramosis 10–15 mm. longis fultis (Plate VII, Fig. 1), cylindricis ad 6 mm. longis, 1.5 mm. crassis, sporophyllis apiculo parvo rhombeo scarioso terminatis; bracteis sub amento lanceolato-acuminatis ad 2.5 mm. longis; strobilis foemineis ignotis.

DISTRIBUTION: In Bolivia, Sailapata in Ayopaya, Cochabamba.

SPECIMENS EXAMINED:

BOLIVIA: Cochabamba: Ayopaya: Sailapata, 2700 m., *Cardenas 3053* (TYPE in †U.S. Nat. Herb., A).

Cross-sections of leaves show upper hypoderm interrupted; vascular and auxiliary sclereids absent.

19. **Podocarpus Parlatorei** Pilger in Pflanzenreich IV. 5 (Heft 18): 86. 1903; Pilger in Nat. Pflanzenfam. ed. 2, 13: 247. 1926; Lillo, Contr. Arboles Argent. 20. 1910; Herzog in Veg. der Erde 15: 151, 159, 165. 1923; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 280. 1931; Covas, Revista Argentina Agron. 6: 26. 1939.

Podocarpus angustifolia Parlatore in DC. Prodr. 16(2): 512. 1868, non Grisebach.

A shrub or tree up to 10 m. tall with trunk up to 70 cm. in diameter with brown, somewhat fissured bark, branching from near the ground, having numerous sub-verticillate branchlets. Terminal buds spherical with scales carinate, acutate, or long apiculate. Leaves thin coriaceous, scattered, fairly erect to patent, narrowly linear, gradually angustate to the spine at tip, narrowing at base to a short broad petiole, 3–8 cm. long, 2–4 mm. wide, mature leaves with revolute margin and with upper surface flat or with an open shallow groove; a narrow ridge at midvein on lower surface. Cross-sections of leaves show continuous upper hypoderm. Pollen cones 3–6 fascicled on angular peduncles 6–15 mm. long or with more than this number of cones per peduncle due to cymose branching near the top. Bracts beneath cones lanceolate, 2 mm. long, followed by numerous broadly ovate apiculate scales. Microsporophylls with an evident triangular upturned apiculus. Female cones on peduncles 5–10 mm. long, appearing with new foliage, solitary in axillary position; receptacle 3–4 mm. long of about 3 fused scales bearing a single ovule (seldom 2) with

* Named in honor of Martin Cárdenas, one of the most well-known of the South American botanists, who, working at the Simón Bolívar University, Cochabamba, Bolivia, is directing research, collecting, and is active in numerous projects furthering botany in South America.

the free upper end of the fertile bract very short and membranous. Seed spherical 5–6 mm. long, 4–5 mm. wide, with a very blunt, inconspicuous crest. Pollination in mid-November at 700 m. near Tucuman.

DISTRIBUTION: Southern Peru, Bolivia and northern Argentina at elevations from 1700–3000 m.

SPECIMENS EXAMINED:

PERU: Torontoy, *Cook & Gilbert 1188* (US).

BOLIVIA: Cochabamba: *Steinbach 6025* (A, F). Tarija: *Cardenas 133* (GH); Rincon de la Victoria, *West 8417* (GH, †Mo, UC). Tomina: *Carriker in* 1937 (Ph). Province unknown: Sierra de la Cruz, *Kuntze 92* (NY-2 sheets), *Fiebrig 3569* (ex Berlin Herb.) (F).

ARGENTINA: Prov. Tucuman: El Saladillo, *Jorgeson 82* (GH, †Mo, US); Tafi, *Wetmore 912* (US), *Venturi 9811* (A, †Mo, US), *Venturi 9246* (US); Chicligasta, *Venturi 4594* (A,-CAS, †F, GH, Mo, UC, US), *Venturi 2978* (US); Burroyaeo, *Venturi 7725* (CAS, GH-2 sheets, †Mo, US). Prov. de Salta: Quachipas, *Venturi 9811* (GH); Candelaria, *Venturi 8753* (US, A).

20. **Podocarpus salignus** D. Don in Lambert, Pinus **2**: 20. 1824, ed. 2, **2**: 120. 1828; Pilger in Pflanzenreich IV. 5 (Heft 18): 82. 1903; Pilger in Nat. Pflanzenfam. ed. 2, **13**: 247. 1926; Bailey, Cult. Conif. 33. 1933; Florin in Svenska Vet.-Akad. Handl. ser. 3, **10**(1): 280. 1931.

Podocarpus chilinus L. C. Rich. in Ann. Mus. Hist. Nat. Paris **16**: 297. 1810 (nomen), Comm. Conif. 11, pl. 1, fig. 1. 1826; Endlicher, Syn. Conif. 212. 1847; Gay, Fl. Chilena **5**: 402. "1849" (1852); Gordon, Pinetum 270. 1858, ed. 2, 329. 1875; Carrière, Traité Conif. **2**: 649. 1867; Parlatore in DC. Prodr. **16**(2): 511. 1868; Neger in Bot. Jahrb. **23**: 403. 1896; Worsdell, Trans. Linn. Soc. London, ser. 2, **5**: 301. 1897; Van Tieghem in Bull. Soc. Bot. France **38**: 169. 1891; Reiche, Veg. der Erde **8**: 63–64. Leipzig 1907; Dallimore & Jackson, Handb. Conif. 40. 1923, 1931.

A much branched tree up to 20 m. high, twigs slender, their terminal buds small, ovoid, scales long attenuate or less often distinctly apiculate. Leaves spreading, linear lanceolate, sometimes falcate, long angustate toward apex, tapering below to a short petiole (several mm. long), 6–12 cm. long, 3–8 mm. wide with a narrow ridge above midvein, less distinct or drying wrinkled and flat below. Leaf cross-sections show the upper hypoderm interrupted. Pollen cones axillary to scales and closely aggregated near tips of twigs or axillary to leaves and more scattered, linear filiform cylindrical 2–3.5 cm. long, 1–1.5 mm. wide, with microsporophylls devoid of an apiculus. Seed cones solitary, axillary on slender peduncles, 8–20 mm. long, receptacle about 6–8 mm. long, bearing 1–2 ovules, of 2–3 fused scales with small tips, the upper part becoming abruptly divergent when 2 seeds develop. Seeds oblong with a prominent blunt crest, 7–8 mm. long and 3–3.5 mm. wide.

DISTRIBUTION: Mountains of central and southern Chile, up to 900 m. Frequently cultivated.

SPECIMENS EXAMINED:

CHILE: Maule: Cordillera de Maule, *Gay* (ex Herb. Mus. Paris) (GH, US). Coronel: *Ochsenius* in 1862 (GH, †Mo). Prov. Nuble: Recinto, *Pennell 12491* (GH, F, †NY, Ph). Concepcion: *Looser 3270* (GH). Prov. Malleco: Pailahueque, *Joseph 4860* (US), *Joseph 4935* (US); *Pirion 212* (GH); Puren, *Bohn* in 1919 (F); Ercilla, *Kuntze 92* (NY-2 sheets); Panquipulli, *Joseph 2577* (US), *Joseph 2409* (US). Cautin: Near Temuco, *Sargent* in 1906 (A, Mo). Valdivia: Coral, *Krause* s.n. (†US); *Junge 429* (Mo), *Gunckel 46* (F), *Anon.* in 1908 (Mo);

San Juan, *Anon.* in 1900 (A), *Anon.* in 1872 (GH); Quitaluto, *Gunckel 899.3* (UC); Osorno, *Morrison 17658* (GH, UC); La Union, *Bohn 1111* (A, Mo); *Philippi* in 1888 (US), *Philippi* in 1863 (A, F, NY), *Werdermann 354* (A, CAS, GH, F, Mo, †NY, UC, US), *Werdermann 353* (CAS, F, GH, Mo, NY, UC, US), *Hollermayer 306* (NY), *Buchtien* in 1896 (GH, US), *Buchtien* in 1898 (A), *Lerchler 467* (GH). Province not given: Austro-Andina, *Poeppig* (†F, †Mo), *Anon.* (ex Herb. Mus. Paris) (NY), *Bean* in 1912 (A), *Bridges* (NY).

CULTIVATED: Kew: *Nicholson 64* (A), *Nicholson 71* (A); Windsor Park, *Parker* in 1903 (A). California: Golden Gate Park, *Buchholz* in 1942 (Ill), *Eastwood* in 1916 (CAS), *Walther* in 1920 (A), *Walther* in 1923 (CAS), *Walther* in 1924 (A), *Walther 152* (CAS, NY); *Anon.* (ex Gordon Herb.) (A).

21. **Podocarpus Sprucei** Parlatore in DC. Prodr. 16(2): 510. 1868; Gordon, Pinetum 348. 1875.

Podocarpus glomeratus Pilger in Pflanzenreich IV. 5 (Heft 18): 86. 1903, in part, non D. Don; Pilger in Nat. Pflanzenfam. ed. 2, 13: 247. 1926, in part; Dallimore & Jackson, Handb. Conif. 46: 1931, in part; sensu Diels in Bibliotheca Bot. (Heft 29) 116: 57. 1937; sensu Rimbach in Flora (Quito, Ecuador) 2: 119. 1942 non D. Don; Rimbach, Tropical Woods 31: 3. 1932.

A tree up to 10 m. high (often dwarfed to a shrub at high altitudes) with reddish brown bark longitudinally furrowed and with numerous leaves crowded on sub-verticillate branches. Terminal vegetative buds relatively large, globose with coriaceous carinate scales, the outer lanceolate, apiculate or short-acute, the inner ovate, acute or obtuse scales, both kinds with scarious denticulate margins. Leaves erect to sub-patent, stiffly coriaceous, straight or sub-falcate, linear elliptical or linear-lanceolate, glossy dark green, some with shallow open groove above, others with a low ridge above midvein, paler and striate bluish green lower surface, usually shortly angustate at tip. Leaves near ends of twigs sometimes pungent, those belonging to early leaves of a growth cycle may be broadly acute or obtuse without a prickle. Leaves gradually narrowed at base to a short petiole or sub-sessile, about 2.5–4 cm. long, 3–5.5 mm. wide (up to 7 cm. long on vigorous lower branches or saplings), the margins usually slightly revolute. Leaf cross-sections show interrupted hypoderm, vascular and auxiliary sclereids absent. Pollen cones (Plate VII, Fig. 3) fascicled in groups of 6–10 or more on stout axillary 15–25 mm. long peduncles, the peduncles usually scaly or leafy and corymbosely branched above, cylindrical, 2–2.5 mm. in diameter, up to 10 mm. long, subtending bracts 5 mm. long, the sporophyll with a broadly obtuse scarious apex. Occasional pollen cones may also be found axillary, solitary and sub-sessile. Ovulate cones (Plate VII, Fig. 2) on axillary peduncles 3–7 mm. long, receptacle 6–7 mm. long. Seeds sub-globose 7–8 mm. long, minutely crested with a ridge along side.

While *P. Sprucei* Parl. was placed as a synonym under *P. glomeratus* by Pilger with his description broadened to include both species, we have become convinced that these are different species and should be treated as such. It is not so easy to separate them on the basis of single characters because both of them vary considerably, yet when all differences are considered they do stand apart.

Podocarpus Sprucei is not glaucous on the lower side of the leaf, whereas *P. glomeratus* is normally very glaucous. It has wider leaves, many of them obtuse or broadly obtuse without the prickle. The pollen cones

differ as may be seen in the descriptions, are larger in *P. Sprucei*, more numerous per cluster and have much longer bracts subtending the outer cones. The seeds of *P. Sprucei* are larger, on longer peduncles.

It is likely that for both species several varieties may become recognizable. The cultivated specimens represented by *Rose & Rose 22307* show the longest leaves.

DISTRIBUTION: In Ecuador, central and western cordillera from Chimborazo north into Colombia.

SPECIMENS EXAMINED:

ECUADOR: Parama de Naba, *Spruce 5519* (ISOTYPE, †F, GH); Andes west of Cuenca, *Lehmann 4812* (†F); Chimborazo, *André 139* (F, GH, NY); *André 3937* (F, GH, NY, †US); Western Cordillera, Rio Chimbo, *Rimbach 626* (†F, NY, US); central Ecuador, *André 138* (F, GH, NY); locality not given, *Mutis 637* (probably collected in Ecuador by Caldas) (US).

CULTIVATED: Ecuador: vicinity of Huigra, *Rose & Rose 22307* (F, NY, GH, US).

22. **Podocarpus Lambertii** Klotzsch in Endlicher, Syn. Conif. 211, 1847; Eichler in Fl. Brasil 4(1): 432, pl. 115. 1863; Carrière, Traité Conif. 648. 1867; Parlatore in DC. Prodr. 16(2): 512. 1868; Van Tieghem in Bull. Soc. Bot. France 38: 169. 1891; Pilger in Pflanzenreich IV. 5 (Heft 18): 86. 1903; Dallimore & Jackson, Handb. Conif. 48. 1923, 1931; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 279. 1931.

Podocarpus angustifolius Niederl. in Hauman & Vanderv. Mus. Nat. Buenos Aires 29: 7. 1917, non Parl.

A large tree with numerous branches and branchlets, sub-verticillate with crowded foliage. Terminal buds spherical, scales broadly ovate, obtuse, with thin scarious margins (outer bud scales of 2-year-old seedling apiculate). Leaves erect to patent, linear, obtuse, or acute, and pungent, shiny, either flat or with midrib obscure or with open groove above, dull beneath, with a broad ridge below midvein, up to 3–4 cm. long, 2–3 mm. wide. Sections of leaves show continuous hypoderm, no vascular nor auxiliary sclereids. Pollen cones numerous, 3–6 at tip of naked axillary peduncle, those of *Glaziou 7852* 5 mm. long (10–15 mm. long, 2.5 mm. wide on a cultivated plant *Hoehne 14484*). Female cones solitary on peduncles 5–8 mm. long; receptacle about 4 mm. long, of a pair of fused scales, with free scale.

SPECIMENS EXAMINED:

BRAZIL: Minas: Morro Cavado, *Glaziou 7852* (†F, US); *Sellow* (ex Herb. Mus. Hist. Nat. Vindob.) (†F); Campos do Jordao, *Harshberger 934* (Penn, †US); San Paulo, *Netto 4432* (US).

CULTIVATED: Brazil: San Paulo, Ypiranga Horto do Mus. *Hoehne 4628* (NY).

22a. **Podocarpus Lambertii** var. **transiens** Pilger in Pflanzenreich IV. 5 (Heft 18): 86. 1903.

This plant differs from species in having a few of outer terminal bud scales apiculate, its linear-lanceolate leaves 2.5–5 cm. long, 3.5–5 mm. wide, with more broadly acute or obtuse tips, not pungent or scarcely sharp pointed. Pollen cones (based upon a cultivated specimen, *Lueder-waldt 14844*, with longer leaves and some of them pungent) numerous, 3–6 at tip of peduncles 10–14 mm. long, cylindrical, 10–15 mm. long, 2.5 mm. wide.

SPECIMENS EXAMINED:

BRAZIL: Serra de San Jose, *Glaziou 16335* (GH, NY, †US); *Glaziou 17779* (†F); Serra do Cipó, *Barreto & Brade 1145* (†F).

CULTIVATED: Brazil: San Paulo, Ypirango Horto ex Mus. Paulista 6431, *Luederwaldt 14484* (A).

23. **Podocarpus Leonii** Carabia in Caribbean Forester 2: 92. 1941.

An arborescent shrub or small tree 6–7 m. high. Terminal buds ovoid with scales arising from a broad base, thin at margins, carinate and long apiculate. Twigs densely leafy, with leaves crowded when on short shoots (internodes 2–6 mm. on longer shoot with internodes more than 1 cm.). Leaves patent to more spreading, coriaceous, straight or seldom falcate, elliptical, tending toward oblanceolate, acute and pungent apiculate, narrowed below into a very short petiole, 2–5 cm. long, 5–10 mm. wide with midvein flat or scarcely at all impressed above and narrowly prominent below. Pollen cones unknown. Female cones solitary, axillary, on peduncles 4–5 mm. long, with upper free ends triangular. Seed ovoid, 8 mm. long, 4 mm. wide, with a distinct 1 mm. long conical crest.

DISTRIBUTION: In eastern Cuba, Oriente, Sierra de Imas, Purton del Mote, at 500 m. elevations.

SPECIMENS EXAMINED:

CUBA: *Leon 12192* (type coll. †NY), *Leon 12193* (†NY); *Shafer 8785* (†NY).

This entity resembles a previously described variety, *P. Buchii* var. *latifolius*, from nearby Haiti. However, the latter has slightly longer peduncles and somewhat longer leaves than this type specimen of *P. Leonii*. There may be other differences. The differences among the Cuban and Haitian species seem to have the value of varieties rather than species. However, there are available, thus far, so few specimens from Haiti and Cuba that we do not feel justified in placing these in synonymy. One might suggest that in this region there are species in the making that deserve most careful study from numerous collections in several localities of both islands — differences that may have arisen since the separation of these mountain masses by the Windward Passage.

24. **Podocarpus Victorinianus** Carabia in Caribbean Forester 2: 92–93. 1941.

An arborescent shrub, many-branched, the branches lax. Terminal buds ovoid with long apiculate, erect or spreading scales arising from a broad base, carinate and scarious at margins. Leaves lax, straight or very slightly falcate, elliptical, 3–5 cm. long, 10–13 mm. wide, acute and pungent-apiculate at tip, narrowed into a short petiole below, essentially flat above and below with ridge at midvein only near base. Pollen cones unknown. Female cones on peduncle of unknown length; receptacle of a pair of fused scales with free apices obtuse, becoming very fleshy, 15 mm. long and 10 mm. wide. Seed single, 10 mm. long, 5 mm. wide with a conical curved or oblique 2 mm. long crest.

DISTRIBUTION: Only collection from Monte Verde, Oriente, in Eastern Cuba.

SPECIMEN EXAMINED:

CUBA: Oriente, Monte Verde, *Wright 1461* mounted on left half of sheet bearing a specimen of *P. aristulatus*, also *Wright 1461* (†GH).

25. **Podocarpus angustifolius** Grisebach in Cat. Pl. Cubensis 217. 1866; Van Tieghem in Bull. Soc. Bot. France 38: 169. 1891; Pilger in Pflanzenreich IV. 5 (Heft 18): 89. 1903, excl. syn.; Dallimore & Jackson, Handb. Conif. 39. 1923, 1931, excl. syn.; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 279. 1931; Florin in Arkiv. Bot. 25A(5): 2. 1934, excl. *P. aristulata* Parl.; Carabia in Caribbean Forester 2: 92, 1941.

An arborescent shrub with sub-verticillate branches and spreading foliage. Buds spherical or ovoid with broad carinate scales bearing long slender apiculus. Leaves linear, patent, sub-coriaceous, narrowed toward apex ending in a spine, on upper side with a slight ridge above midvein, revolute at margin when mature, with a narrow ridge at midvein on lower side, narrowed near base into a short petiole, 4–7 mm. long, 3–4.5 mm. wide. Pollen cones axillary to leaves of previous year's growth, sessile, cylindrical, 10–15 mm. long, 3 mm. wide, the microsporophylls with upturned broadly obtuse, scariously dentate tips. Ovulate cones on peduncles 2.5 to 4.5 mm. long, receptacle of a pair of scales connate below, unequal, spreading and obtuse above, becoming fleshy. Seed 7 mm. long, crested.

DISTRIBUTION: Only collections from western Cuba, on Pinar del Rio, Sierra del Organos, El Retiro Gripo de Rosario, San Diego de Tapia and San Miguel (Carabia).

SPECIMEN EXAMINED:

CUBA: *Wright 3188* (fragment ex Gottingen Herb., †GH, †Mo, NY, US, YU).

26. **Podocarpus aristulatus** Parlatore in DC. Prodr. 16(2): 513. 1868; Carabia in Caribbean Forester 2: 91. 1941.

Podocarpus Purdieanus f. *parvifolia* Grisebach in Mem. Amer. Acad. Sci., n. ser. 8: 530. 1862, non Parl.

Podocarpus Purdieanus sensu Grisebach in Fl. Br. West-Ind. 505. 1864, non Hook.

Podocarpus angustifolius var. *Wrightii* Pilger in Pflanzenreich IV. 5 (Heft 18): 89. 1903.

An aborescent shrub becoming a tree with sub-verticillate branches. Buds spherical with outer scales narrowly ovate, carinate, strongly apiculate and scarious at margins. Leaves sub-patent to spreading, coriaceous and shiny, up to 4 cm. long, 5–7 mm. wide, somewhat oblanceolate, broadly acute at the aristate apex, narrowed below into a short petiole, essentially flat on upper surface or with a suppressed ridge above midvein, sometimes slightly revolute at margins, with midvein more prominent below than above. Pollen cones cylindrical, axillary to leaves or bracts of previous year, sessile, 9–12 mm. long, 3–3.5 mm. wide. Microsporophylls with scarious broadly obtuse upturned apex. Ovulate cones on peduncles 2–3 mm. long, receptacle of 2 connately fused scales, spreading and obtuse, becoming fleshy above, up to 7 mm. long, the sterile scale narrow and shorter. Seed 7–9 mm. long, 4–5 mm. wide, edged by a ridge and with a pronounced crest.

DISTRIBUTION: Mountains of eastern Cuba.

SPECIMENS EXAMINED:

CUBA: Monte Verde, *Wright 1461* (ISOTYPE, GH, †Mo, NY, YU); Monte La Plancha, *Carabia 3843* (†NY), *Roig 162* (†NY); Farallon de la Perla, *Shafer 8785* (US).

27. **Podocarpus Ekmanii** Urban in Fedde, Repert. Spec. Nov. Reg. Veg. 18: 17. 1922; Florin in Arkiv. Bot. 25A: 1. 1934; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 279. 1931; Carabia in Caribbean Forester 2: 91. 1941.

A shrub 2–4 m. tall with thickly leafy branchlets (internodes 1–3 mm. long). Buds nearly ovoid with broadly rounded carinate scales, the outer with a mucro about half as long as scale. Leaves stiffly coriaceous, straight or slightly falcate, linear-lanceolate, with spine at apex, narrowed below and sub-sessile, 1.5–2.5 cm. long, 3–4 mm. wide, flat or with a slight ridge above midvein on upper surface, the margins tending to be revolute and with midvein prominent below, where there are fine longitudinal striations on each side of midvein. Pollen cones unknown. Ovulate cones on short peduncles 1–2 mm. long; receptacle of 2 fused scales 3–4 mm. long, connate below, spreading above, with free triangular apices, becoming bright red when ripe. Seed ovoid 6–7 mm. long, 3.5–4 mm. wide, with ridge and a conical crest 1 mm. long.

DISTRIBUTION: Mountains of eastern Cuba at 500–900 m. alt.

SPECIMENS EXAMINED:

CUBA: Sierra de Cristal, *Ekman 6790* (type coll. †Herb. Stockholm); Sierra Moa, *J. A. Shafer 8058* (†NY, US); Camp San Benito, *J. A. Shafer 4086* (NY).

28. **Podocarpus Buchii** Urban in Fedde Repert. Spec. Nov. Reg. Veg. 19: 298. 1924; Florin in Arkiv. Bot. 25A: 2. 1934; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 279. 1931; Moscoso, Cat. Florae Domingensis 1. 1943.

A tree 6 m. or more high with dark green crowded foliage. Terminal buds nearly globose with orbicular carinate scales, the outer ones apiculate, the inner blunt. Leaves stiffly coriaceous, straight or only slightly falcate, linear-lanceolate, ending in a stiff spine 1–1.5 mm. long, narrowed at base to a 1 mm. long petiole, or sub-sessile, 1.5–2.8 cm. long, 4.5–6.5 mm. wide (*Ekman 1403* from type locality has leaves up to 4 cm. long and 9 mm. wide, may be juvenile or belong to var. *latifolius*), with midvein somewhat prominent above toward base of leaf, obscure and slightly impressed toward tip, very conspicuous on lower side, stomatal rows conspicuous as longitudinal stripes. Pollen cones unknown. Ovulate cones axillary on peduncles 7–8 mm. long, receptacle of a pair of fused carinate scales, 8–10 mm. long, becoming very fleshy. Seeds elliptical 7–8 mm. long, 4–4.5 mm. wide, with a very prominent flat recurved crest, 1–1.5 mm. long.

DISTRIBUTION: In mountains of Haiti near Bellefontaine.

SPECIMENS EXAMINED:

HAITI: Morne Montie, *Ekman 5738* (†ex Florin); Massif de la Belle, *Ekman 1403* (US); Mornes des Commissairos, *Holdridge 1252* (US).

28a. **Podocarpus Buchii** var. **latifolius** Florin in Arkiv Bot. 25A: 3. 1934; Moscoso, Cat. Fl. Domingensis 1. 1943.

Podocarpus angustifolius var. *Wrightii* Urban in Symbolae Antill. 8: 4. 1920.

An arborescent shrub or small tree with larger leaves up to 10 cm. long and 10 mm. wide, with a groove above midvein in many of its leaves, otherwise similar to typical form of species. (*Nash & Taylor 1715*, a shrub 4–6 ft., with leaves up to 5.8 cm. long and 10 mm. wide may represent a large juvenile foliage.) Female cones on peduncles 4–7 mm. long, receptacle a pair of fused scales 3–4 mm. long, connate below, divergent above. Seed ellipsoidal 6–7 mm. long, 3.5–4 mm. wide, with a prominent conical flattened crest, smaller but very similar to species.

DISTRIBUTION: Haiti in Massif du Nord.

SPECIMENS EXAMINED:

HAITI: Morne Belanse, *Ekman 4913* (ISOTYPE, †US), *Nash & Taylor 1715* (US).

This variety is very similar to *P. Leonii* Carabia but differs in having longer peduncles and receptacle, and somewhat smaller seeds. The plants are probably closely related in their origin and each has undergone slight changes since becoming isolated from the Cuban mountains by the Windward Passage.

29. **Podocarpus nubigenus** Lindley in Paxton, Flow. Garden 2: 162, fig. 218. 1851–52, in Jour. Hort. Soc. 6: 264. 1851; Gay, Fl. Chilena 5: 404. "1849" (1852); Carrière, Traité Conif. 650. 1867; Parlatore in DC. Prodr. 16(2): 513. 1868; Van Tieghem in Bull. Soc. Bot. France 38: 169. 1891; Pilger in Pflanzenreich IV. 5 (Heft 18): 82. 1903; Pilger in Nat. Pflanzenfam. ed. 2, 13: 247. 1926; Reiche, Veg. der Erde 8: 63–64. Leipzig 1907; Dallimore & Jackson, Handb. Conif. 53. 1923, 1931; Covas, Revista Argentina Agron. 6: 24. 1939; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 279. 1931.
Saxe-Gothaea gracilis Hort. ex Gord. Pinet. 280. 1858.

A tree up to 15 m. or more in height. Branches short, sub-verticillate and sub-opposite, thickly leafy, clothed by decurrent leaf bases, forming a grooved surface. Buds conically ovoid, of coriaceous lanceolate or attenuate pungent scales (Plate VIII, Fig. 1). Leaves stiffly coriaceous, crowded, linear-lanceolate, patent to divaricately spreading, green above with a distinct ridge above midvein, flat beneath but with a pair of glaucous bands (Plate VIII, Fig. 2) on each side of midvein, with stomata confined to these bands, leaving green margins, 2–4 cm. long, 3–5 mm. wide, with pungent or acute tips, narrowed below, sessile, with leaf bases decurrent on the stem. Leaves usually retained for many successive years growth. Cross-section of leaf shows organized transfusion tissue absent; it is represented by a few isolated sclereids only; hypoderm on upper side is continuous. Pollen cones solitary, axillary, or fascicled 1–3 mm. peduncles, usually aggregated near tips of twigs (Plate VIII, Fig. 2), and arising on twig of newest growth, subtended by triangular, carinate, apiculate bracts, sessile, or when clustered or fascicled on peduncles up to 5 mm. long, cylindrical, 9–15 mm. long, 2.5 mm wide. Microsporophylls with prominent, broadly obtuse and scarious margined upturned apiculus. Female cones (Plate VIII, Fig. 3) axillary, of a pair of fused, thickened, unequal scales with spreading triangular apices, becoming fleshy, on peduncles 1–1.5 mm. long. Seed sub-globose, elongated by a very blunt crest, about 9 mm. long and 8 mm. wide.

DISTRIBUTION: Open woods in very wet places, 50–780 m. altitude, in southern Chile and Argentina (49° S. Lat., the southernmost range of Podocarpus).

SPECIMENS EXAMINED:

CHILE: Santiago: *Ames* in 1906 (US). Valdivia: Hills above Corral, *West 4885* (GH, Mo, UC), *Gunckel 57* (†F, Mo), *Sargent* in 1906 (A, †Mo); Cordillera de la Costa, *Anon.* (A); Osorno, *Morrison 17628* (GH, UC); Cordillera Pelade, Chaihuin, *Gunckel 3029* (A); *Krause* s.n. (US); *Trevianus* in 1863 (ex Philippi) (NY); *Buchtien s.n.* (US). Chiloe: King's Collector, (NY); *Junge 90* (†Mo); Almán, *Espinosa 113* (Mo); Puerto Montt, *Joseph 3308* (US). Patagonia: Eden Harbor, *Ball* in 1882 (GH, NY); *Hill* in 1872 (GH). Province not given: *Cunningham* in 1866–67 (GH), *Husbands 850* (US).

ARGENTINA: Rio Negro Territoria, between Puerto Blest and Laguna Frias, *West 4829* (UC), Lago Nahuel Huapi, Puerto Blest, *Cabrera 6087* (GH).

EXPLANATION OF PLATES

PLATE I

FIGURE 1. *Podocarpus Reichei, Carlos Reiche* in 1927 from Puebla, Mexico, showing long-attenuate vegetative bud scales, detached seeds at right, immature buds of male cones on twig at left. Natural size.

FIGURE 2. *Podocarpus Pittieri, Steyermark 55098* from Federal District, Venezuela, showing auxiliary sclereids in palisade and mesophyll. × 65.

FIGURE 3. *Podocarpus Roraimae* Pilger, *Steyermark 58949* from Mt. Roraima, Venezuela, showing large hypoderm fibers and the large lumen of the lower hypoderm fibers. × 65.

PLATE II

FIGURE 1. *Podocarpus Matudai* var. *macrocarpus, Matuda 956* on April 5, 1936, from Mt. Ovando in Chiapas, Mexico, showing long vegetative bud scales, long peduncles of seeds. Natural size.

FIGURE 2. *Podocarpus Matudai* var. *macrocarpus, Steyermark 48589* from Guatemala, showing three seeds which had been kept in alcohol and on the right a single dried seed for comparison. Both from the same specimen. Natural size.

PLATE III

FIGURE 1. *Podocarpus Pittieri, Steyermark 57035* from Federal District, Venezuela. Epidermis, × 570.

FIGURE 2. *Podocarpus Rusbyi, Rusby 2463* from Mapiri, Bolivia. Epidermis, × 570, showing smaller cells and thickened walls at corners.

FIGURE 3. *Podocarpus Steyermarkii, Steyermark 60876* from Bolivar, Venezuela, showing deep groove at upper midrib, single resin canal, fibers above and below vascular bundle, wing-like transfusion tissue with accessory transfusion tissue extending from above and below into blade of leaf. × 65.

PLATE IV

FIGURE 1. *Podocarpus Rusbyi, Rusby 2463* from Bolivia, showing long vegetative bud scales, seeds with obtuse crest. Natural size.

FIGURE 2. *Podocarpus trinitensis, Broadway 7151* from Trinidad, showing seed with obscure crest. Natural size.

PLATE V

FIGURE 1. *Podocarpus guatemalensis* Standley, *Standley 25090* from Puerto Barrios, Guatemala, showing very small vegetative bud with short scales. Natural size.

FIGURE 2. Bud of above specimen enlarged. × 5.

PLATE VI

FIGURE 1. *Podocarpus guatemalensis* var. *pinetorum, Bartlett 13109* from Pine Ridge, British Honduras, showing prominent midrib, interrupted hypoderm at midrib, and fibers above vascular bundle. × 65.

FIGURE 2. *Podocarpus pendulifolius, Steyermark 57115* from Tachira, Venezuela, showing blunt, rounded, almost swollen margin and doubled hypoderm. × 65.

FIGURE 3. *Podocarpus oleifolius, Smith 6856* from Mt. Poas, Costa Rica, showing vegetative bud with short obtuse scales and immature pollen cones. Natural size.

PLATE VII

FIGURE 1. *Podocarpus Cardenasii, Cardenas 3053* from Cochabamba, Bolivia, showing vegetative bud with attenuate scales and pedunculate clusters of pollen cones. Natural size.

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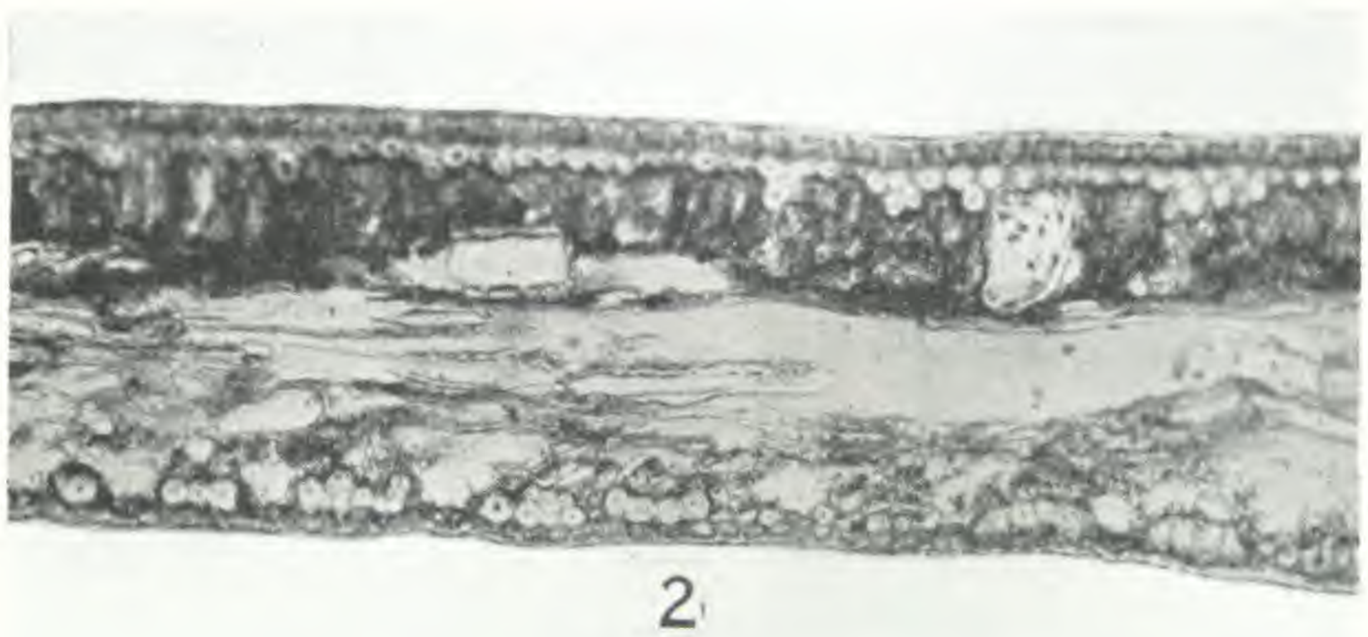

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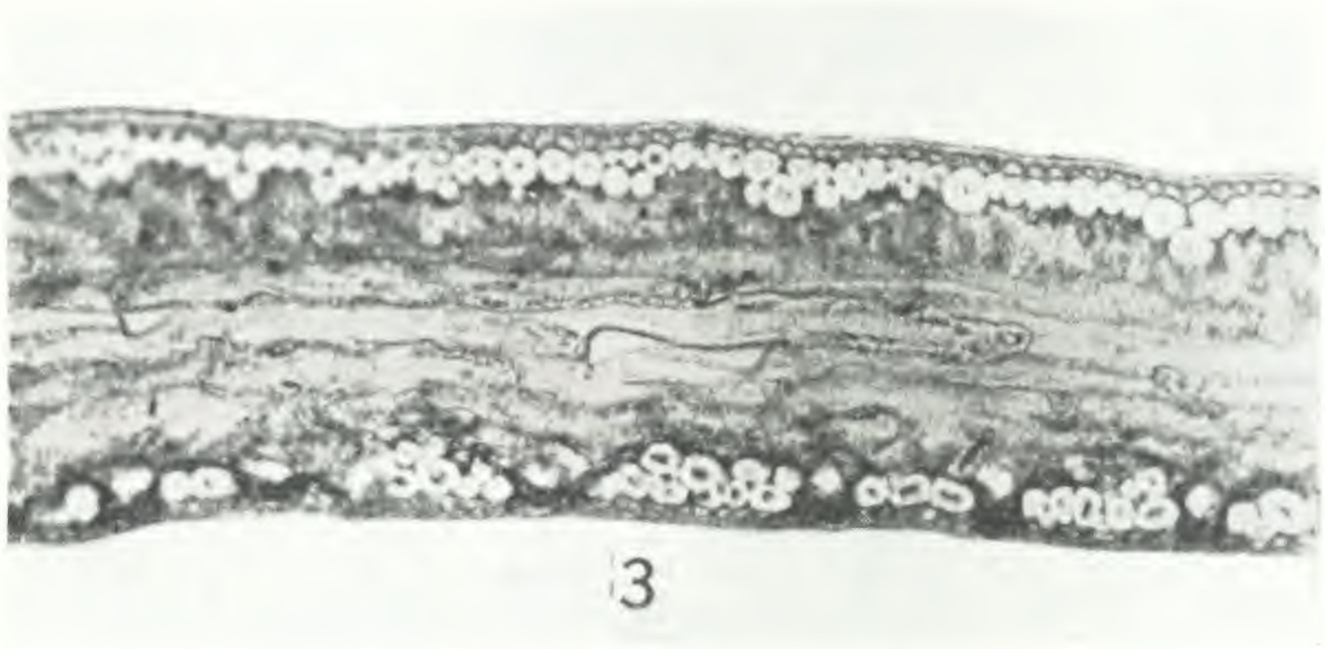

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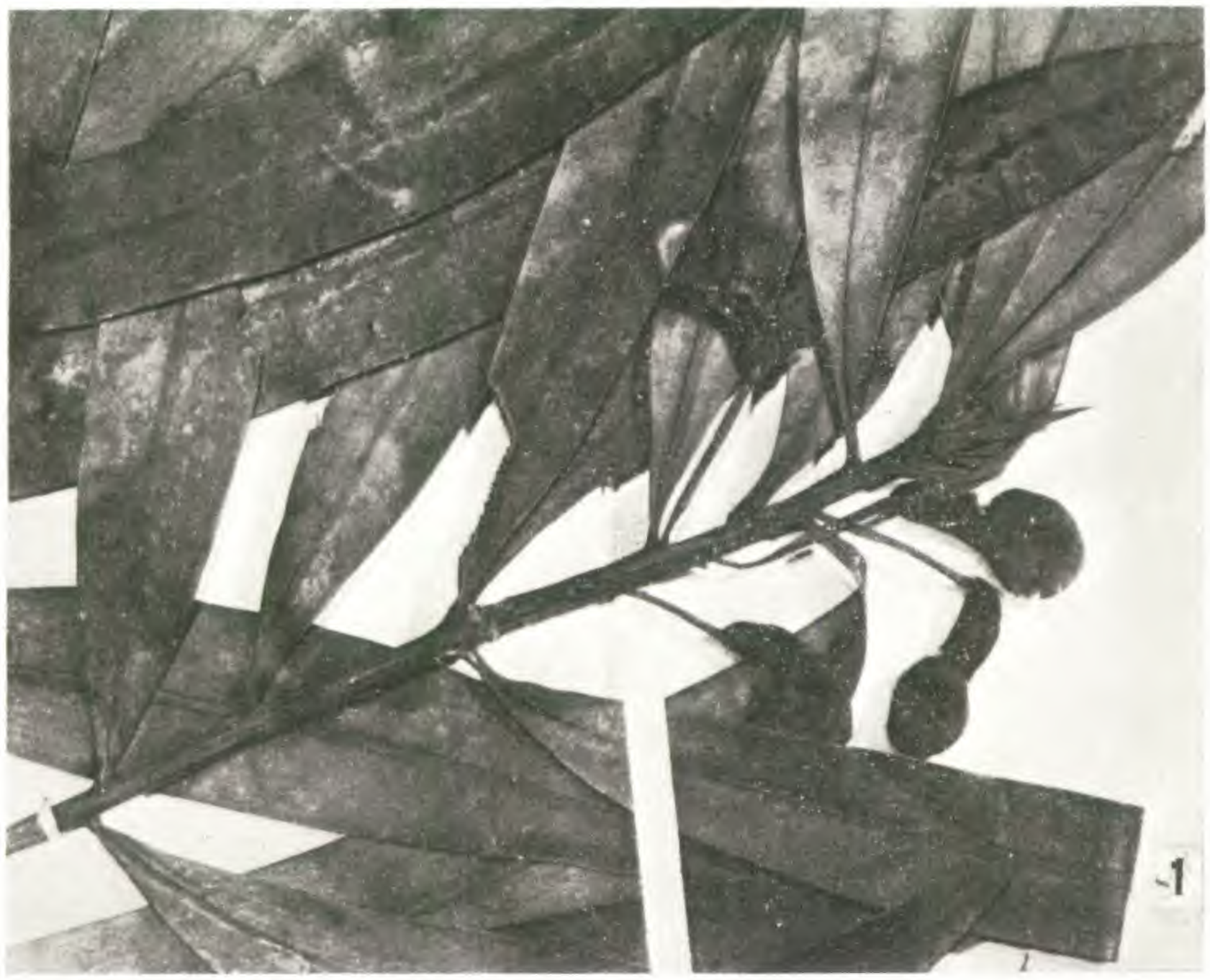
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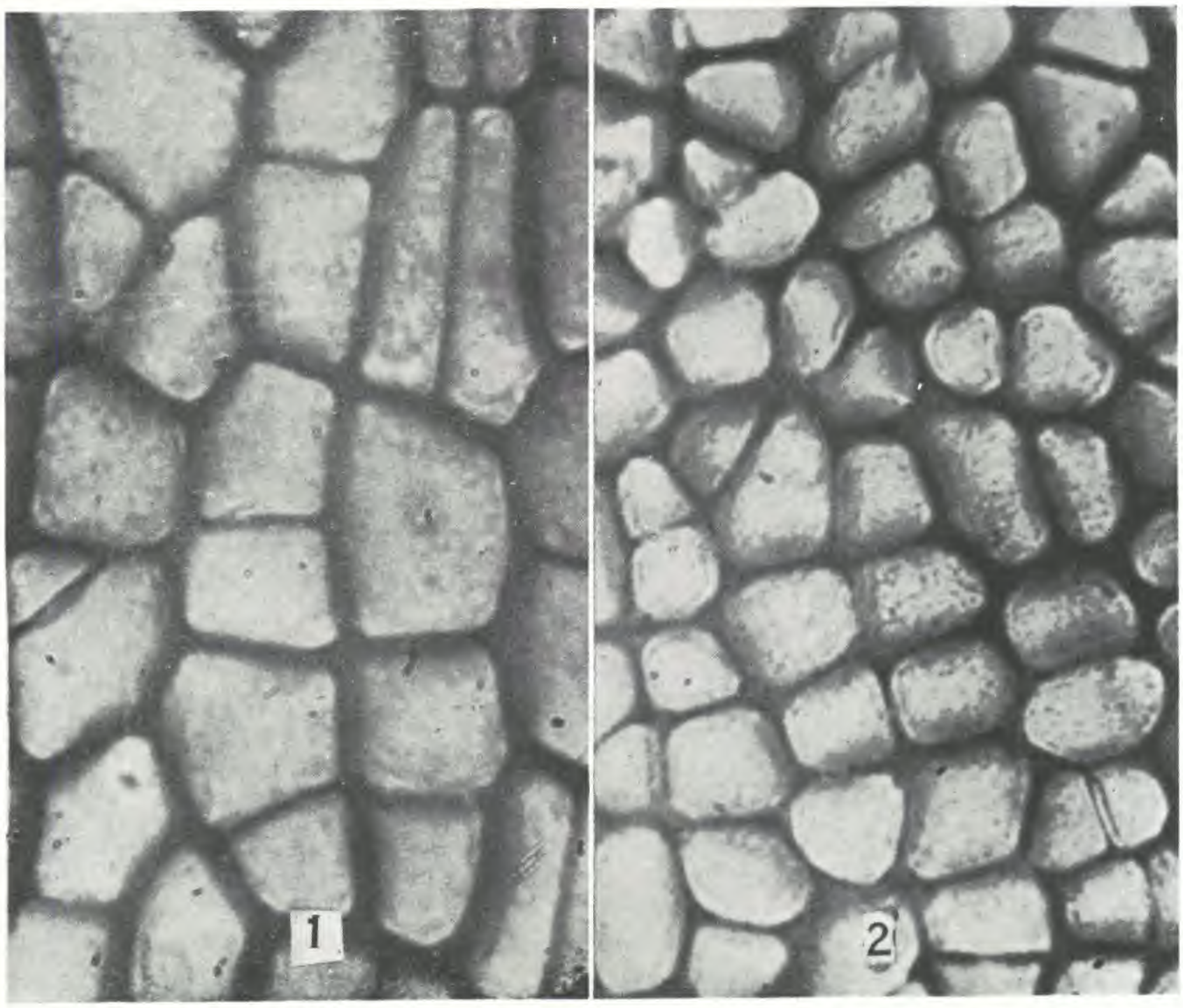
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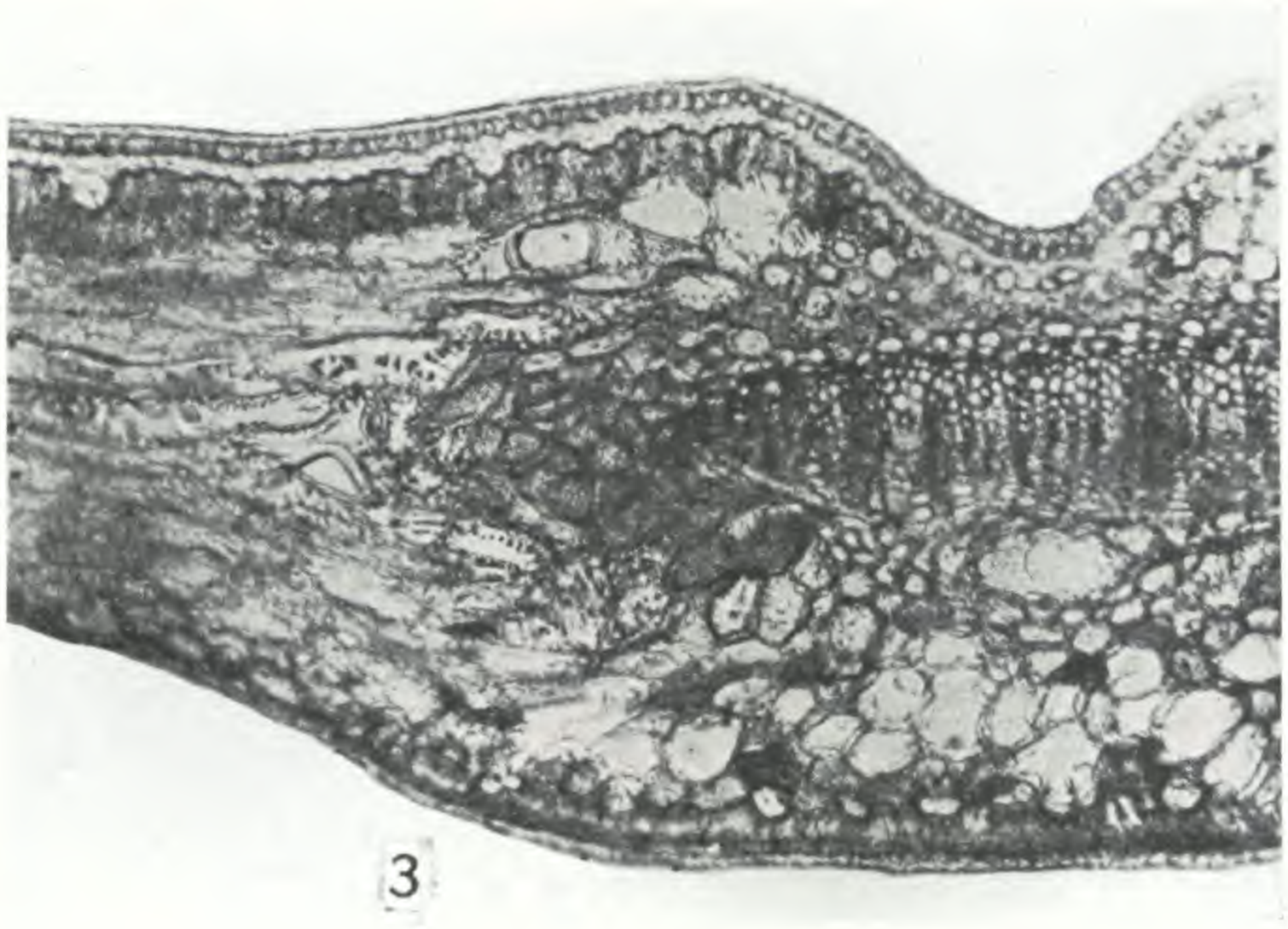
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Rusby 2463 NY
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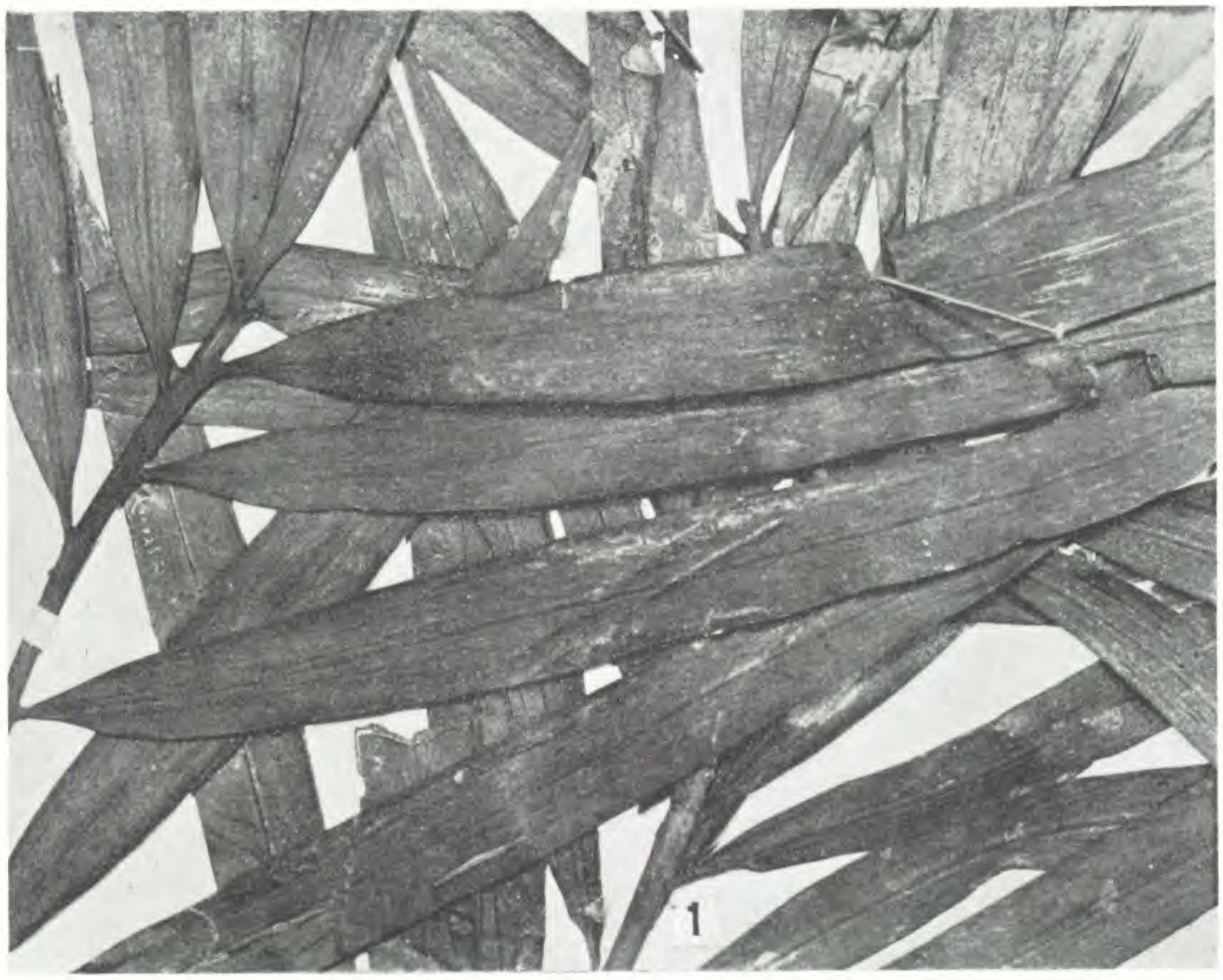
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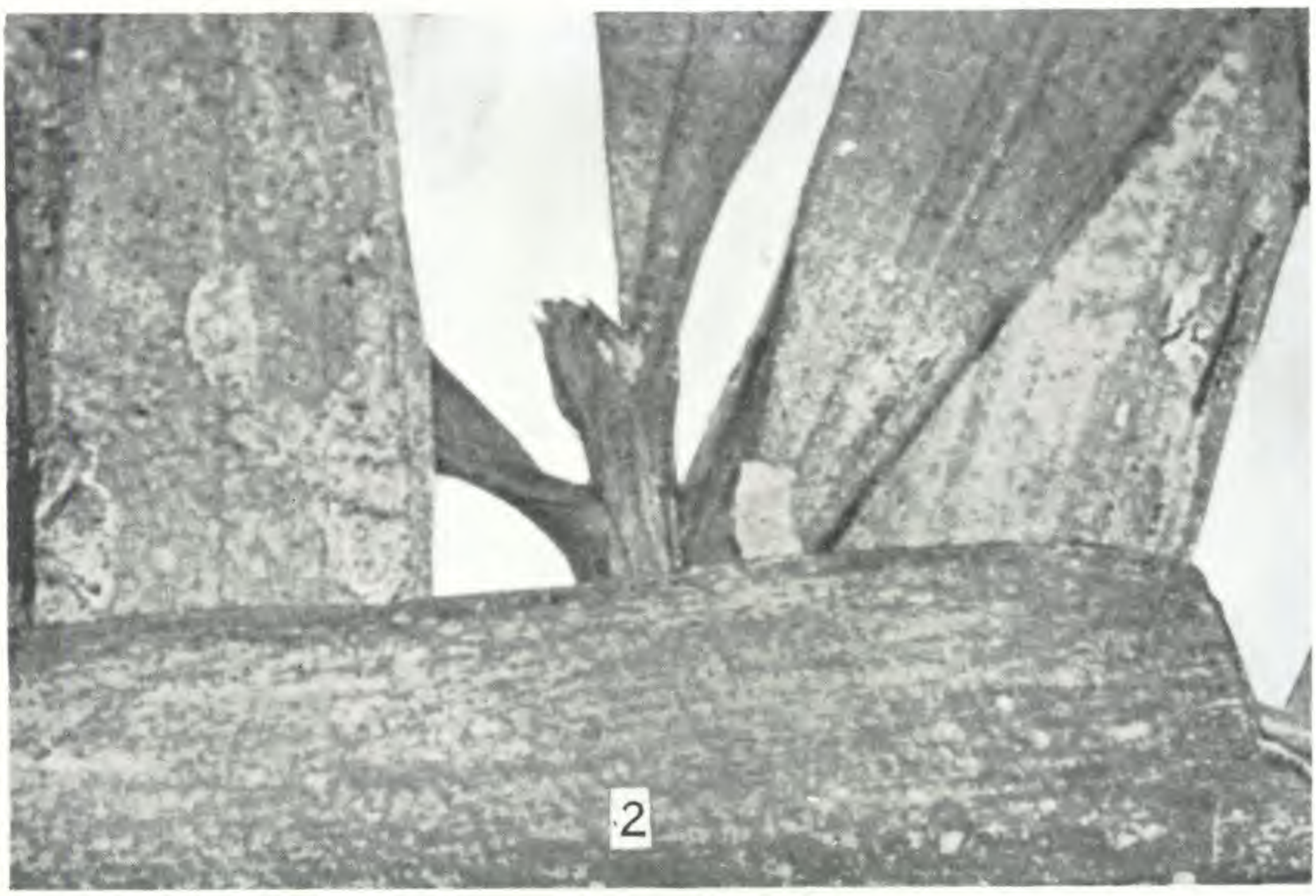
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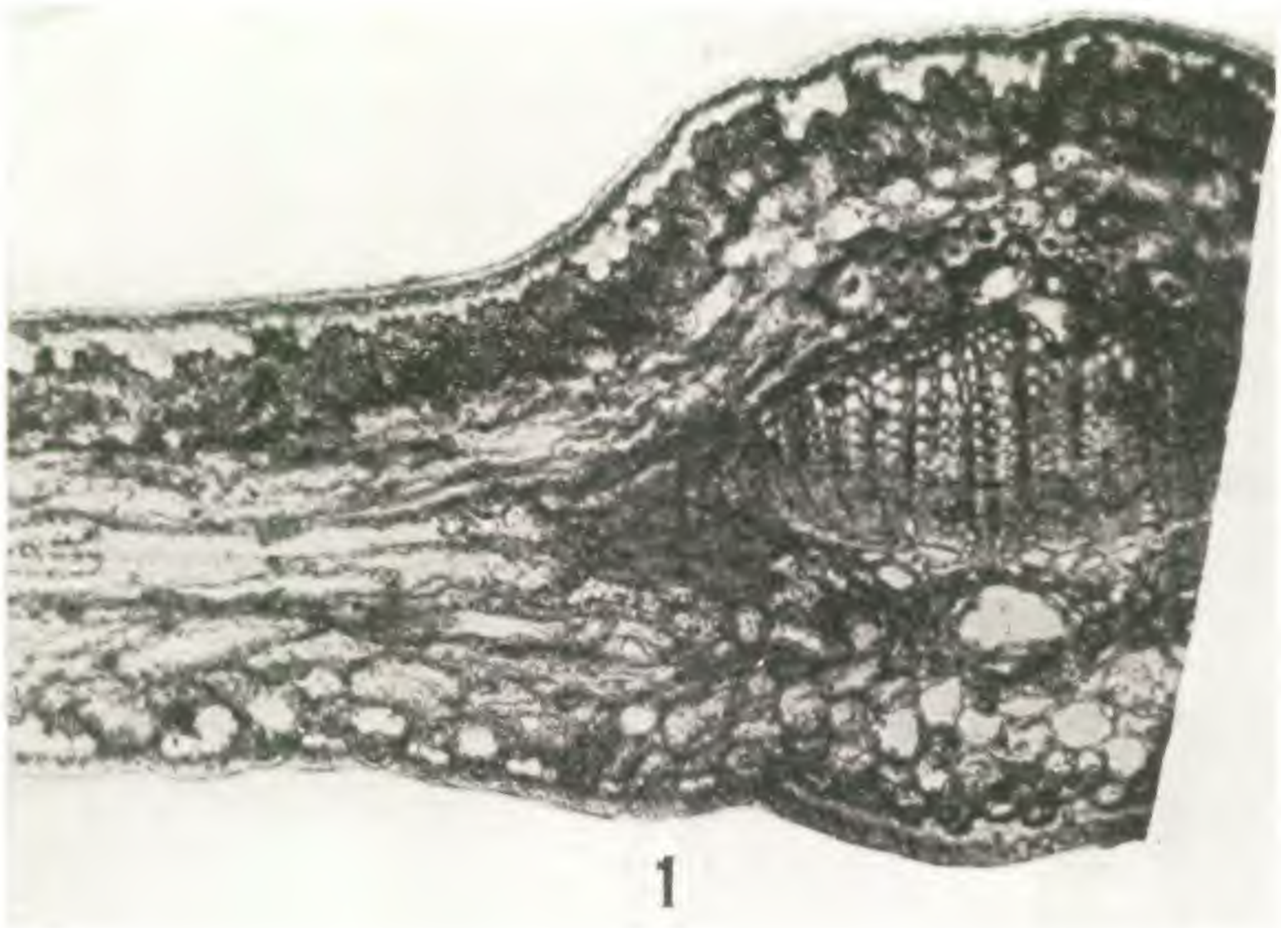

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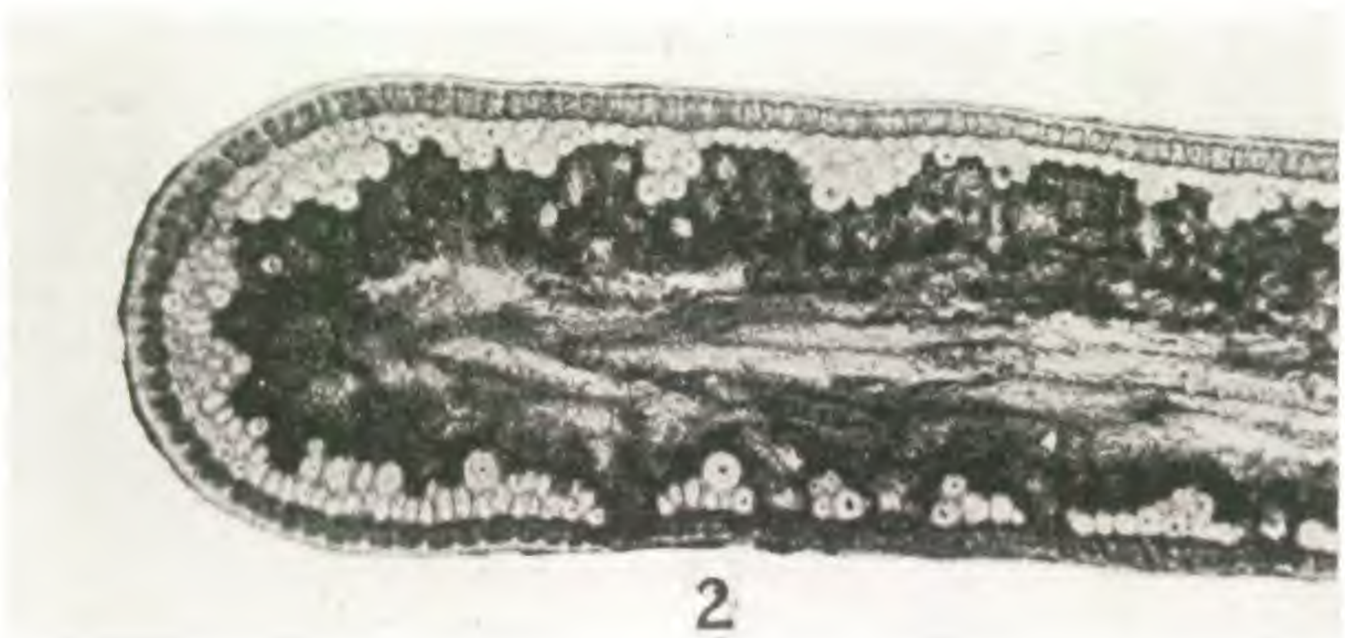

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REVISION OF PODOCARPUS

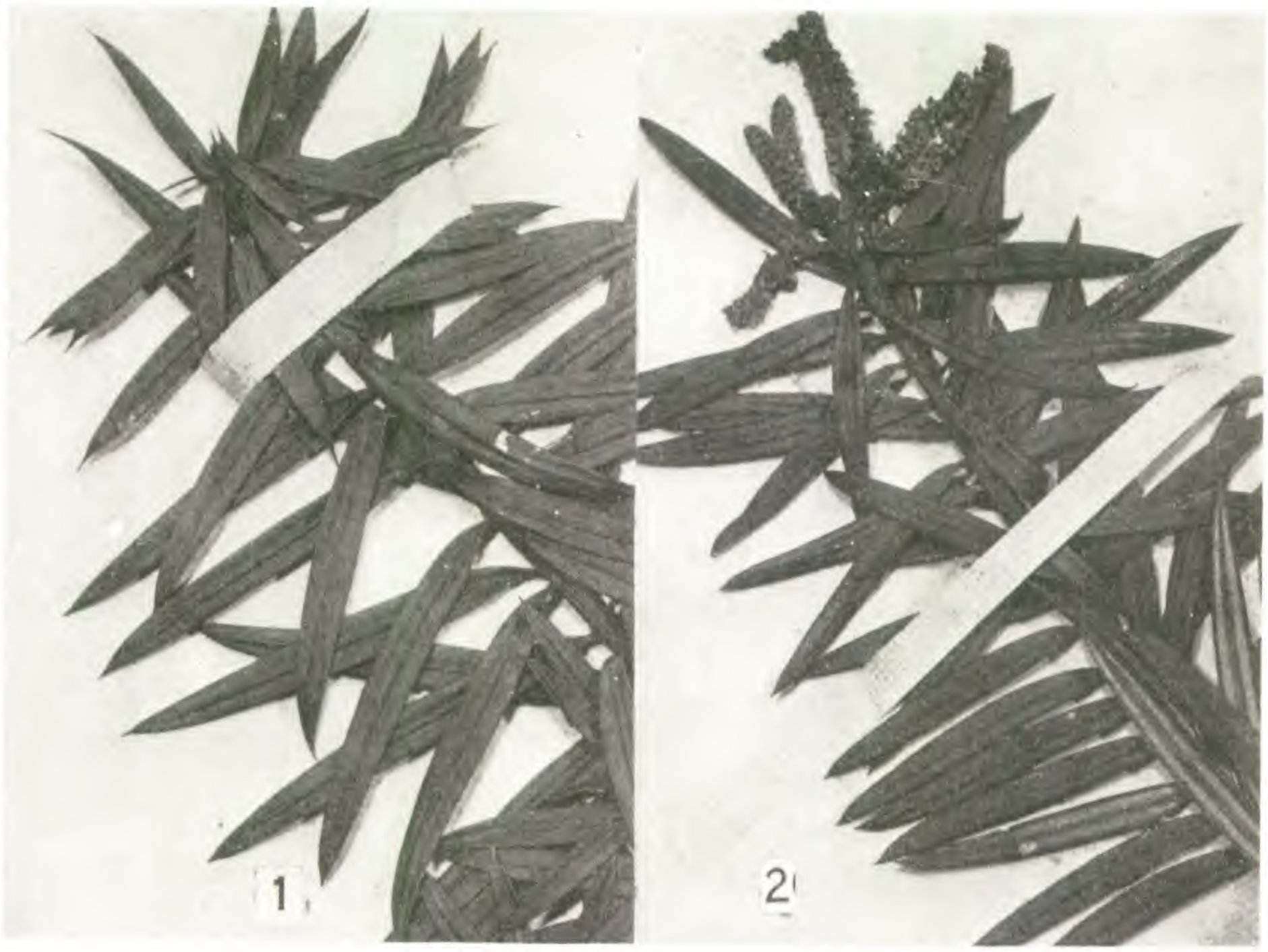
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FIGURE 2. *Podocarpus Sprucei* Parl., *Spruce 5519* from Parama de Naba, Ecuador. Female branch. Natural size.

FIGURE 3. *Podocarpus Sprucei* Parl., *Lehmann 4812* from the Andes west of Cuenca, Ecuador. Male branch. Natural size.

PLATE VIII

FIGURE 1. *Podocarpus nubigenus* Lindl., *Gunckel 57* from Valdivia, Chili, showing vegetative bud. Natural size.

FIGURE 2. *Podocarpus nubigenus* Lindl., *Gunckel 3029* from Valdivia, Chili, showing pollen cones and glaucous bands on under side of leaves. Natural size.

FIGURE 3. *Podocarpus nubigenus* Lindl., *Ball* in 1882 from Patagonia, Chili, showing fruit with short peduncles. Natural size.

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NOTES ON SOME PAPUAN COLLECTIONS OF MARY STRONG CLEMENS

E. D. MERRILL AND L. M. PERRY

THIS PAPER consists of records of various species of flowering plants occurring in Northeastern New Guinea, formerly Kaiser Wilhelms Land; 20 species and 2 varieties are described as new. The collector, Mrs. Mary Strong Clemens, has prosecuted field work in the region for several years, sending her material to Berlin for identification previous to the development of the present world war. When Germany became involved in war she commenced to send her botanical material to Professor H. H. Bartlett of the University of Michigan and he in turn provided us with a study-set. Thus the species discussed in this paper are represented in the Herbarium of the University of Michigan and in the Herbarium of the Arnold Arboretum. The actual types are preserved in the latter institution.

Late in December, 1941, or early in January, 1942, Mrs. Clemens was evacuated from Lae, with other Caucasian residents, to Port Darwin, Northern Territory, Australia, and is now at Brisbane, Queensland, Australia. Being evacuated from New Guinea by airplane she was forced to leave behind all of her equipment and her assembled botanical collections and it is highly probable that all this material has been lost or destroyed. Our work on the Clemens New Guinea collection has been prosecuted in connection with our studies of the extensive botanical collections made by Mr. L. J. Brass on the three Richard Archbold Expeditions to New Guinea — Port Moresby and the Owen Stanley Range; the Fly River region; and the Mount Wilhelmina region in the Snow Mountains of Netherlands New Guinea. We also have the Brass and Kajewski collections made for the Arnold Arboretum in New Guinea and the Solomon Islands which are being studied in conjunction with the New Guinea collections from other sources.

BALANOPHORACEAE

Balanophora Oosterzeeana Valeton, Nov. Guin. 8: 919. *t. 161.* 1913; Ridl. Jour. Linn. Soc. Bot. II. 9: 147. 1916; Lam, Nat. Tijdschr. Nederl.-Ind. 88: 277, 294. 1928, 89: 131. 1929; Harms in Engler & Prantl, Pflanzenfam. ed. 2, 16b: 334. 1935.

NORTHEASTERN NEW GUINEA: Boana, *Clemens 4169,* May–November 1940, alt. 750–1630 m.

The species has been reported from several localities in Netherlands New Guinea, but this seems to be the first record from Northeastern New Guinea.

ARISTOLOCHIACEAE

Aristolochia dictyophlebia sp. nov.

Scandens; caulibus tortis teretibus inconspicue pubescentibus; foliis rigide coriaceis pellucido-punctatis, petiolatis, petiolo 2–2.5 cm. longo ±

dense pubescente, lamina late lanceolata 10–19 cm. longa 3–7 cm. lata apice longe acuminata basi auriculata, supra subnitida, novella consperse minute pilosa, subtus minute pilosa, nervis basalibus tantum 3 ceteris utrinsecus 3 vel 4 supra distinctis subtus prominentibus, reticulo clathrato supra manifesto subtus prominulo; inflorescentiis axillaribus 4 cm. longis axi dense pubescente; floribus pedicellatis, pedicellis ± 1 cm. longis dense pilosis, bracteis minutis; perianthio 3 cm. longo extus pubescente intus glabro, basi dilatato vix 1 cm. longo hinc augustato sursum dilatato, tubo curvato 1.5 cm. longo, limbo hypocrateriformi trilobo lobis 1 cm. diametro rotundatis apiculatis costatis; gynostemio 3.5 mm. longo, antheris 6 oblongis 1.8 mm. longis; stigmatibus 6 circiter 2 mm. longis; ovario 1 cm. longo, 6-loculari, longitudinaliter sulcato.

NORTHEASTERN NEW GUINEA: Ogeramnang, *Clemens 4901* (TYPE), January 1937, alt. about 1650 m., forest hill (vine; flowers dull wine-purple with yellow); Sattelberg, *Clemens 1927*, March 1936, alt. 1020 m., roadside up mountain (vine on small tree or shrubby bamboo; flowers dark purple or wine with pale markings).

These collections were sent to us under the name *Aristolochia pithecurus* Ridl. The flower does not at all correspond with the original description of that species. We have indicated elsewhere that this type ought to be re-examined.

We have another collection from this same region: Kulungbufu, *Clemens 6520*, June 1937, alt. about 1600 m. The leaves are shortly acuminate or at times almost obtuse with a very short acumen. With the leaf-specimen was a single detached 6-winged immature fruit 5.5 cm. long. In the axils of the leaves are branching axes of inflorescences up to 10 cm. long with scars 5 mm. or more apart. Whether or not the fruit belongs here we cannot say. The venation of the leaves is similar to that in our species but the leaves are shorter in proportion to their width, the axis of the inflorescence is stouter and much longer than in the material we have chosen for the type. The fruit is unlike that of any other described New Guinean *Aristolochia*.

Aristolochia crassinervia O. C. Schmidt, Bot. Jahrb. 58: 491. 1923.

NORTHEASTERN NEW GUINEA: Boana, *Clemens 41750*, August 1940, alt. about 900 m., small vine near drome at mountain base.

This collection agrees well with the description of the type. We note, however, that on all the veins of the lower leaf-surface are short fine spreading hairs, a character not mentioned in the original diagnosis.

Aristolochia tagala Cham. Linnaea 7: 207, *t. 5. f. 3.* 1832; Merr. Enum. Philip. Fl. Pl. 2: 120. 1923.

Aristolochia megalophylla K. Schum. in K. Schum. & Hollr. Fl. Kaiser Wilhelms Land 104. 1889; Warb. Bot. Jahrb. 13: 300. 1891; K. Schum. Notizbl. Bot. Gart. Berl. 2: 113. 1898; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 302. 1900; Rechinger, Denkschr. Math.-Nat. Kl. Akad. Wiss. Wien 89: 549. 1913; Lauterb. Bot. Jahrb. 52: 106. 1914.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10769*, alt. 240–600 m.; Boana, *Clemens 41622*, alt. 750–1350 m.

Although the leaves of this specimen are a little larger than are those in our Philippine collections, we fail to note any characters by which the two

species may be distinguished. Lauterbach in his summary of the New Guinea species recognized this and suggested that the two might be varietal. *Aristolochia tagala* Cham. is a species of wide geographic distribution.

POLYGONACEAE

Polygonum attenuatum R. Br. Prodr. Fl. Nov. Holl. 420. 1810; Danser, Bull. Jard. Bot. Buitenz. III. 8: 162. *f. 5*. 1927.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10601*, August 1939, alt. 240 m., near a small lake.

This species has been recorded by Danser from Australia and Timor.

CHENOPODIACEAE

Chenopodium carinatum R. Br. Prodr. Fl. Nov. Holl. 407. 1810; F. M. Bail. Queensl. Fl. 4: 1243. 1901.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10814*, November 1939, alt. ± 540 m., open place near village.

This seems to be the first *Chenopodium* record for New Guinea. The species is Australian, and judging by the habitat and Mrs. Clemens' note, "have seen this in Markham Valley growing with tobacco," this is an adventive rather than a native species in New Guinea.

RANUNCULACEAE

Clematis Gouriana Roxb. ex DC. var. **malaiana** Miq. Ann. Mus. Bot. Lugd.-Bat. 4: 66. 1869.

Clematis Vitalba Linn. var. *javana* (DC.) O. Ktze. Verh. Bot. Ver. Prov. Brandenb. 26: 100. 1885; K. Schum. & Hollr. Fl. Kaiser Wilhelms Land 47. 1889; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 311. 1900.

Clematis Gouriana Roxb. sensu Kaneh. & Hatus. Bot. Mag. Tokyo 52: 354. 1938.

NORTHEASTERN NEW GUINEA: Wantoat, *Clemens 11027A*, January 1940, alt. 1050–1800 m. (small vine; flowers white).

Miquel's name is the oldest varietal one for this plant, although it seems to have been overlooked.

Clematis Pickeringii A. Gray var. **novo-guineensis** var. nov.

A forma typica differt foliis interdum simplicibus coriaceis, nervis primariis conspicuis, reticulo manifesto.

NORTHEASTERN NEW GUINEA: Yunzaing, *Clemens 4148* (TYPE of var.), September 1936, on small trees of forest hills (small vine; flowers white).

In the *Clematis* collections from Papuasia, this specimen is the closest to Fijian material representing typical *Clematis Pickeringii* A. Gray. This is a staminate collection with somewhat obovate flower-buds and anthers with a very short appendage at the apex of the connective as in the Fijian material; the leaves, on the other hand, are sometimes simple and definitely coriaceous, and the primary venation is conspicuous.

Clematis papuasica Merr. & Perry var. **pubescens** var. nov.

A typo recedit ramulis novellis crispe hirtellis, foliolis supra parce, subtus ± dense hirtellis; pedicellis brevibus 0.5–1 cm. longis.

NORTHEASTERN NEW GUINEA: Matap, *Clemens 40979* (TYPE of var.), February-April 1940, alt. 1500–1800 m. (vine with cream flowers); Wantoat, *Clemens*

11170, February 1940, alt. 1050–1800 m.; Sattelberg, *Clemens 1098*, December 1935, alt. 750–900 m.; Wareo, *Clemens 1356*, December 1935, alt. 600 m.

This variety differs from the type in the more copious pubescence of the branchlets, the inflorescences and the leaves. In the specimens cited there is considerable variation in pubescence. *Clemens 1356* has leaves almost glabrous enough to belong to the species.

Clematis perspicuinervia sp. nov.

Frutex scandens; ramulis novellis leviter sulcatis glabris; foliis simplicibus valde coriaceis ellipticis 6–12 cm. longis 3–6 cm. latis, basi rotundatis apice abrupte acuminatis, acumine 1–1.5 cm. longo, margine integris vel supra medium parce dentato-serratis, 5-nervatis, trabeculis et reticulo utrinque prominulis; petiolo 1.5–7 cm. longo; paniculis axillaribus quam foliis longioribus; axi, ramulis et pedunculis minute fulvo-pubescentibus; sepalis 4; staminibus 4, antheris aristatis; achaeniis ± 20, immaturis, ovato-oblongis 1 mm. longis hirtellis in stylum persistentem, pilis longis plumosum, curvatum 1–2 cm. longum attenuatis.

NORTHEASTERN NEW GUINEA: Ogeramnang, *Clemens 4447* (TYPE), November 1936, alt. 2300 m.

The number of sepals and the anther-characters are drawn only from very small undeveloped buds. The specimen is very fragmentary, but it appears to be distinct enough by its simple strongly coriaceous leaves, the larger ones dentate above the middle, and the venation being very obvious on both surfaces.

Ranunculus Keysseri Schlechter in Diels, Bot. Jahrb. **62:** 479. 1929.

NORTHEASTERN NEW GUINEA: Golinteng, Sarawaket, *Clemens 5307*, February 1937, alt. 2100–2400 m., wet open place; Ulap Trail, *Clemens 41149*, April 1940, alpine. Previously known only from the type-collection.

LEGUMINOSAE

Maniltoa lenticellata C. T. White, Jour. Arnold Arb. 8: 130. 1927, op. cit. 10: 220. 1929.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, near Markham River, *Clemens 10617bis*, August 1939, alt. 240–600 m. Previously known from British New Guinea.

Cassia Absus Linn. Sp. Pl. 376. 1753; J. G. Baker in Hook.f. Fl. Brit. Ind. 2: 265. 1878; Koorders, Exkursionsfl. Java 2: 368. 1912.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10692*, September 1939, alt. 240–270 m., Markham Valley grassland (flowers reddish yellow). Probably introduced.

Crotalaria alata Hamilt. ex D. Don Prodr. 241. 1825; Roxb. Hort. Beng. 98. 1814, *nomen nudum*, Fl. Ind. ed. 2, 3: 274. 1832; K. Schum. Notizbl. Bot. Gart. Berl. 2: 119. 1898; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 350. 1900.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10654*, *40775*, August-December 1939, alt. 240–600 m. Previously reported from Papuasia on the basis of a collection from the Bismarck Archipelago.

Crotalaria chinensis Linn. Syst. ed. 10, 1158. 1759; Merr. Enum. Philip. Fl. Pl. 2: 272. 1923.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10776*, August-December 1939, alt. 240–600 m. India, southern China, Malaya, and the Philippines.

Desmodium velutinum (Willd.) DC. Prodr. 2: 238. 1825; Schindl. in Rep. Spec. Nov. 21: 6. 1925.

Hedysarum velutinum Willd. Spec. Pl. 3(2): 1174. 1802.

Hedysarum lasiocarpum Beauv. Fl. Oware Benin 1: 32. *t. 18*. 1804 [1805].

Hedysarum latifolium Roxb. Fl. Ind. ed. 2, 3: 350. 1832.

Desmodium latifolium DC. Prodr. 2: 328. 1825; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 355. 1900.

Desmodium lasiocarpum (Beauv.) DC. Prodr. 2: 328. 1825.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10632D, 10830K*, August-December 1939, alt. 240–600 m. Reported from several places in Papuasia as *D. latifolium* DC.

Desmodium tortuosum (Swartz) DC. Prodr. 2: 332. 1825.

Desmodium purpureum Fawcett & Rendle, Fl. Jamaica 4: 36. 1920, non Hook. & Arn.

NORTHEASTERN NEW GUINEA: Finschhafen, *Clemens 4215*, September 1936, near harbor; Kajabit, Markham Valley, *Clemens 10509*, July 1939, alt. 2400–3000 m. An American species introduced.

Glycine tomentosa Benth. Fl. Austr. 2: 245. 1864; F. M. Bail. Queensl. Fl. 2: 423. 1900; C. T. White, Proc. Roy. Soc. Queensl. 34: 35. 1922; Merr. Enum. Philip. Fl. Pl. 2: 304. 1923.

NORTHEASTERN NEW GUINEA: Kajabit, Markham Valley, *Clemens 10542*, August 1939, alt. 2400–3000 m., grassland. Previously reported for New Guinea from Yule Island, Papua.

Mucuna Clemensiae sp. nov.

Scandens; ramulis petiolis petiolulis pedunculisque fulvo-tomentosis; petiolo 5–6 cm. et rhachi 1.5–2.5 cm. petiolulisque 7 mm. longis, foliolis ovatis vel late ellipticis, 9–12 cm. longis, 6–8.5 cm. latis basi rotundatis lateralibus obliquis apice acutis vel acutiusculis, supra pubescentibus subtus subadpresse villosulis, nervis primariis utrinsecus 6–7 supra distinctis subtus prominulis; inflorescentiis axillaribus racemosis cum alabastris 12 cm., cum fructu 18 cm. longis; alabastro: calyce dense pubescente pilis urentibus conspersis hispido, tubo 8 mm. longo, 6–7 mm. lato, campanulato, lobo superiore 3 mm. longo bilobo rotundato, lobis lateralibus 4 mm. longis 2 mm. latis acutiusculis, lobo infimo 6 mm. longo breviter acuminato; vexillos fere ala aequante; legumine 17 cm. longo 3.5 cm. (suturis alatis 7 mm. inclusis) lato, valvis oblique transversim lamellatis, lamellis circiter 7 mm. latis; seminibus cinereis subnitidis leviter compressis 1.5–2 cm. longis, 1.3–1.5 cm. latis, 1 cm. crassis hilo nigro.

NORTHEASTERN NEW GUINEA: Tobou, *Clemens 6573* (TYPE), June 1937, alt. circiter 1300 m.; Salamaua, *Clemens 46*, August 1935, alt. ± 200 m.; Ewat, *Clemens 11366*, April 1940, alt. 1200 m.

Mucuna Clemensiae is closely related both to *M. cyanosperma* K. Schum. and *M. amblyodon* Harms. The latter apparently has larger flowers and the former a shorter calyx tube with narrower acuminate lobes.

Pueraria textilis Lauterb. & K. Schum. in K. Schum. & Lauterb. Fl. Deutsch. Schutzg. Südsee 368. 1900.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10770, 40781*, August-December 1939, alt. 240–600 m.; Boana, *Clemens 41730*, May-November 1940, alt. 750–1350 m. (flowers purple with cream-colored spot on banner).

In these collections the long hairs on the branches are strongly reflexed.

The flat immature minutely pubescent pods with somewhat undulating margins and curved tips are reflexed along the axis of the inflorescence; fruiting pedicels about 2 mm. long; flowers almost sessile.

Rhynchosia minima (L.) DC. Prodr. 2: 385. 1825; F. M. Bail. Queensl. Fl. 2: 440. 1900; Merr. Enum. Philip. Fl. Pl. 2: 316. 1923.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10618bis*, August 1939, alt. 240–600 m.

Apparently this is the first record of this tropical and subtropical species for New Guinea.

MELIACEAE

Dysoxylum intermedium sp. nov.

Arbor ± 25 cm. diametro; foliis ± 5-jugis impari-pinnatis petiolatis; petiolo 12 cm., rhachi ± 30 cm. longo; foliolis subalternis, 15–22 cm. longis et 8–13 cm. latis, chartaceis, late ellipticis, basi inaequilateralirotundatis vel interdum cuneatis, apice breviter et obtuse acuminatis, supra glabris vel costa et interdum nervis pubescentibus, subtus velutinopubescentibus; nervis primariis utrinsecus ± 12 utrinque manifestis patentibus ad marginem arcuatis, venis subinconspicuis; petiolulis ± 3 mm. longis; paniculis supra-axillaribus (?) vel lateralibus (?) ante anthesi ± 30 cm. longis irregulariter ramosis, ramis ± 10 cm. longis; floribus pedicellatis, pedicellis 3 mm. longis pubescentibus; calyce 3-sepalo, sepalis late rotundatis 3 mm. longis 4 mm. latis extus minute pubescentibus ciliolatis; petalis 5, circiter 13 mm. longis extus dense et adpresse pubescentibus usque ½ longitudinem cum tubo stamineo adnatis; tubo stamineo 11 mm. longo, extus et margine pilosulo, intus infra antheris ± parce pilosulo, antheris 9, circiter 1 mm. longis; tubulo 3.5 mm. longo extus parce, intus dense et retrorse pubescente; ovario cum stylo fere ad apicem dense hirtellis; stigmate capitato.

NORTHEASTERN NEW GUINEA: Matap, *Clemens 11299* (TYPE), February-April 1940, alt. 1500–1800 m. (tree 25 cm. diameter; flowers cream); Ogeramnang, *Clemens 5377*, February 1937, alt. 1750 m.

This species has several characters in common with *Dysoxylum dolichobotrys* Merr. & Perry, of the Solomon Islands, but the inflorescence is not so long and open, the flowers are pedicellate, the buds are more slender, the staminal tube is hairy outside and along the margin and within below the anthers sparingly pilose, and the leaflets are more obtuse.

Chisocheton Weinlandii Harms. in K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee Nachtr. 283. 1905.

NORTHEASTERN NEW GUINEA: Heldsbach, *Clemens 103*, September 1935, forest margin (tree 50 feet; fruit red); Heldsbach, Finschhafen, *Clemens 856*, November 1935; vicinity of Kajabit Mission, *Clemens 10903*, December 1939, alt. 300–600 m., in mountain bush (fruit reddish); Boana, *Clemens 41342*, May-November 1940, alt. 750–1350 m. (tree about 35 cm. diameter; flowers white).

Although we have only the incomplete original description as a basis for the identification of these collections, we venture to add something more about the flowers and fruits. *Clemens 850* was probably collected near the type-locality, and the very young inflorescence is comparable to that of the type. *Clemens 41342* is in a condition approaching anthesis, and

the other two numbers are fruiting material. *Clemens 41342:* dried flower-buds scarcely sericeous very minutely pubescent, petals 13 mm. long; staminal tube 8–8.5 mm. long with crenulate upper margin, glabrous outside, within densely villous from the middle down to the narrow region above the base pressed against the disk; anthers 10, 2.5–3 mm. long, locellate; pistil 9–9.5 mm. long, densely short-hirsute to about 2 mm. below the apex of the style; stigma capitate, ovary 4-loculed; fruit globose, 2.5–3 cm. diameter, younger ones velutinous and apiculate by means of the short style-base; locules 1-seeded.

Aglaia Clemensiae sp. nov.

Arbuscula; trunco 5–12 cm. diametro, ramulis cinereo-brunnescentibus, novellis brunneis adpresse stellato-pubescentibus vel fere lepidotis deinde glabrescentibus; foliis impari-pinnatis 1–3-jugis petiolatis, petiolo 4–7 cm., rhachi 4–8 cm. longo, novellis ± stellato-pubescentibus cito glabratis; foliolis saepissime ellipticis 8–15 cm. longis 5–10 cm. latis basi obtusis vel rotundatis interdum cuneatis leviter inaequalibus apice subrotundatis, novellis consperse (costa venisque densius) et minute stellato-pubescentibus, maturis glabris, venis primariis utrinsecus ± 10 utrinque distincte manifestis; petiolulis 5–10 mm. longis; paniculis axillaribus interdum a basi ramosis, ± 15 cm. longis, ramulis dense minuteque adpresse stellato-pubescentibus, inferioribus ± 5 cm. longis; sepalis 5 late ovatis vel subrotundatis 0.6–0.8 mm. longis latisque, extus stellato-pubescentibus ciliolatis; petalis glabris ellipticis subinaequalibus 1.5 mm. longis 1 mm. latis; tubo stamineo utrinque glabro 0.5 mm. longo margine crenulato, antheris ovatis 0.6 mm. longis in crenulis tubi sessilibus, fere horizontaliter ad centrum inclinatis; ovario minuto pubescente, stigmate globoso glabro.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10691* (TYPE), *10561*, Markham Valley woods, August-September 1939, alt. 270 m. (small tree 2–5 inches in diameter; flower-buds greenish yellow); Sattelberg, *Clemens 1859*, February 1936, alt. 900 m.; Ogeramnang-Malang, *Clemens 4635*, December 1936, alt. 1350 m.

This species belongs to the section *Hearnia* and is perhaps related to *Aglaia Gjellerupii* C. DC. Its best characters are the appressed stellate-pubescent indument and the broad blunt leaves mostly rounded at both base and apex though occasionally cuneate at the base.

CALLITRICHACEAE

Callitriche verna Linn. Fl. Suec. ed. 2, 2. 1755; C. B. Clarke in Hook.f. Fl. Brit. Ind. **2:** 434. 1878; F. M. Bail. Queensl. Fl. **2:** 558. 1900.

NORTHEASTERN NEW GUINEA: Ulap Trail, *Clemens 41125*, April 1940; Sarawaket, *Clemens 5733*, April 1937, alt. 2700 m.

This is the second species of *Callitriche* L. to be reported from New Guinea. The first was collected by the Archbold Expedition to Netherlands New Guinea.

ANACARDIACEAE

Euroschinus papuanus sp. nov.

Arbor 15–18 m. alta; ramulis minute puberulis; foliis 5–7-jugis; petiolo

± 15 cm. longo sub lente puberulo, rhachi 30–40 cm. longo; foliolis vix oppositis disjunctis vel alternis, coriaceis, utrinque glabris, 12–23 cm. longis 4.5–9 cm. latis, oblongo-ellipticis vel infimis ovato-ellipticis basi subrotundatis leviter obliquis vel subaequalibus apice brevissime obtuse acuminatis, nervis primariis utrinsecus 11–14 patenti-adscendentibus marginem versus arcuatim conjunctis prominentibus, venis secundariis prominulis; petiolulo 1–1.5 cm. longo; paniculis in fructu ± 40 cm. longis, ramis inferioribus 6–8.5 cm. longis, ramulis ultimis brevissimis ± 5 mm. longis, puberulis; bracteis lanceolatis 2–3 mm. longis ferrugineo-pubescentibus; pedicello ± 2 mm. longo; calycis lobis 5, circiter 1 mm. longis obtusis glabris; petalis 4 vel 5, oblongis 2.5 mm. longis 1.5 mm. latis obtusis; staminibus 8 vel 10 extra disco insertis, filamentis 1 mm. longis, antheris oblongis 1 mm. longis, connectivo non apiculato; disco 4–5-lobato lobis leviter emarginatis; ovario parvo ± 0.6 mm. longo sessili ovoideo, ovulo infra apicem loculi suspenso; stylo nullo; stigmate 3-lobato; drupis 7–8 mm. longis 6 mm. latis, carnosis compresso-ovoideis leviter obliquis, apice vestigio stigmatico coronatis; semine valde compresso.

NORTHEASTERN NEW GUINEA: Mosum, near Lae, *Clemens 10438* (TYPE), July 1938, alt. ?900 m., open mountain forest (tree ± 18 m.; specimen from branchlets fallen to earth); Sattelberg, *Clemens 177, 599*, September, October 1935, alt. 900 m., forest margin (tree 15–20 cm. diameter; flowers white, stamens yellow; fruit green).

We have been unable to locate any description to match these collections which appear to represent a single species. The flowers differ from those described for *Euroschinus* in that the style is lacking and the anthers are not apiculate. The fruit seems to agree very well with that of the genus.

Rhus lamprocarpa sp. nov.

Arbor 12–15 m. alta; ramulis lenticellatis novellis sparsim pubescentibus cito glabratis; foliis 3–4-jugis, petiolo 3–4 cm., rhachi 7–10 cm. longo, fere glabro, foliolis subcoriaceis 4.5–13 cm. longis 2.5–5.5 cm. latis oblongis vel anguste ellipticis basi leviter obliquis vel interdum subaequalibus rotundatis deinde brevissime cuneatis, apice acutiusculis vel acutis margine integris, supra glabris subtus praecipue costa nervisque pilosulis, nervis primariis utrinsecus 12–14 subtus prominulis, reticulis manifestis; petiolulo 3–8 mm. longo; paniculis ± 10 cm. longis, ramulis minute pubescentibus; pedicellis ± 1 mm. longis, puberulis; floribus glabris; calycis segmentis 5 ovatis obtusis vix 1 mm. longis; petalis 5, oblongis apice rotundatis, 2 mm. longis 1 mm. latis; disco leviter 5-crenulato glabro; staminibus 5, filamentis 0.4 mm. longis, antheris late oblongis 1 mm. longis; ovario circiter 0.6 mm. longo ovoideo, stylis brevibus; drupis compresso-subglobosis 5 mm. longis 6 mm. latis; exocarpio levi nitido, mesocarpio fibroso, endocarpio osseo.

NORTHEASTERN NEW GUINEA: vicinity of Kajabit, *Clemens 10622, 10817* (TYPE), August-December 1939, alt. 240–600 m. (tree 30 cm. or more diam.); Wantoat, *Clemens 10961*, January 1940, alt. 1050–1800 m. (tree 10–15 m. tall; fruits green to bronze); between Bulung River and Kaile, *Clemens 4964*, January 1937, alt. 1200 m., in hill scrub forest.

The species may be near *Rhus novo-guineensis* Lauterb. but the leaves are not usually entirely glabrous, and the disk and the ovary are both

glabrous. The leaves are shorter and the inflorescence less crowded than in *R. taitensis* Guill.

PASSIFLORACEAE

Hollrungia aurantioides K. Schum. Bot. Jahrb. 9: 212. 1888; K. Schum. & Hollr. Fl. Kaiser Wilhelms Land 82. 1889; K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee 456. 1900; Harms, Nat. Pflanzenfam. 3(6a): 86. *fig. 25, E. F.* 1893, op. cit. ed. 2, **21:** 495. *fig. 218, E. F.* 1925.

NORTHEASTERN NEW GUINEA: Ogeramnang, *Clemens 5435*, May 1937, alt. 1680 m.

In the references given above only the type-collection is cited. The species has been collected in fruit in Netherlands New Guinea.

BEGONIACEAE

Begonia Bartlettiana sp. nov. § Diploclinium

Planta parva; caule repente nodis radicanti, internodiis brevibus 1–2 cm. longis; foliis 4–7 cm. longis 3–6 cm. latis, membranaceis, oblique suborbiculari-reniformibus apice saepissime obtusiusculis basi cordatis margine subintegris densiuscule crispule setuloso-ciliatis, supra glabris, subtus ad nervos consperse crispule ferrugineo-pilosis, nervis basalibus 5–7 bi- vel tri-furcatis; petiolo 3–6 cm. longo crispule piloso vel interdum glabro; stipulis glabris lanceolato-ovatis 5–6 mm. longis apice acuminatis; inflorescentiis axillaribus flores ♂ atque ♀ vel tantum ♀ gerentibus; ♂ : pedunculo circiter 4 cm. longo; tepalis 4 glabris, 2 exterioribus rotundatis circiter 5 mm. longis latisque, 2 interioribus oblongis, 4 mm. longis 1.5 mm. latis; staminibus 40–50, filamentis ± 2.5 mm. longis, antheris 0.6–0.8 mm. longis obovatis truncatis vel leviter retusis; ♀ : pedunculo 3–4 cm. longo; tepalis 3 glabris, 2 exterioribus subrotundatis 5–6 mm. longis, uno interiore oblongo, 4–5 mm. longo 2 mm. lato; stylis 3, basi paullo connatis, 3 mm. longis, ad ½ longitudinem in crura 2 spiraliter papillosa fissis; ovario ellipsoideo glabro, alato; capsula cernua 1 cm. longa, 1.2 cm. (alis inclusis) lata, alis 3 rotundatis, 2 circiter 2–2.5 mm. medio latis, una 4 mm. prope basim lata sursum oblique angustata.

NORTHEASTERN NEW GUINEA: Kajabit Mission, *Clemens 10762* (TYPE), October 1939, alt. 300–600 m., in mountain bush on a rock (flowers white).

This species appears to be an ally of *Begonia Sharpeana* F. v. Muell. but is smaller in all its parts; the inflorescence is few-flowered and scarcely at all branched, the stamens are more numerous and the third wing is broadest near the base obliquely sloping towards the apex.

Begonia brachyptera sp. nov. § Sphenanthera

Planta in toto non visa; caule glabro in sicco sulcato; foliis chartaceis novellis minute glanduloso-pubescentibus maturis glabratis, 12–20 cm. longis 10–15 cm. latis, oblique ovato-ellipticis apice abrupte breviter acuminatis, margine inconspicue denticulatis, basi sinu lato cordatis, palmatim 9-nerviis, nervis semel vel bis furcatis; petiolo 14–23 cm. longo; stipulis caducis non visis; inflorescentiis axillaribus flores ♂ et ♀ gerentibus; axi 1–1.5 cm. longa; bracteis rotundatis caducis; ♂ : pedicello 2 cm. longo; tepalis 2 late rotundatis 7 mm. longis 9 mm. latis; staminibus 45–65, filamentis 1–3 mm. longis, antheris 0.8 mm. longis obovato-ellipticis truncatis vel leviter retusis; ♀ : pedicello 1–1.5 cm. longo; tepalis 5 ellipticis 10

mm. longis 7 mm. latis; stylis 3, basi connatis 3 mm. longis ad ½ longitudinem in crura 2 spiraliter papillosa fissis; ovario subtriangulari-ellipsoideo; capsula turbinato-inflato- vel subgloboso-ellipsoidea 1.5 cm. longa 1.1 cm. lata, alis minimis angustissimis versus apicem crassiusculis.

NORTHEASTERN NEW GUINEA: Wantoat, *Clemens 40896* (TYPE), *41205*, January and April 1940, alt. 1200 m.; Busu River, *Clemens 6327*, May 1937, alt. 1800–2100 m.; Upper Ramu, *Clemens 40750* (U. of M.), Sept. 1939, alt. 1200–1500 m. (?), mountain bush.

This species appears to be closely related to *Begonia aptera* Bl. and *B. pseudo-lateralis* Warb. It differs from the former in the 3-loculed ovary and from the latter in the much less sharply cut margin of the leaves and less developed wings of the capsule.

Begonia Clemensiae sp. nov. § Petermannia.

Planta in toto non visa; caule glabro verisimiliter erecto in sicco paullo sulcato; foliis novellis subtus sparsim pilosulis, maturis glabris ovato-oblongis 12–18 cm. longis 5.5–7 cm. latis, apice obtuse acuminatis, basi latere exteriore in lobum cordatum productis nervis basalibus 5, interiore rotundatis nervis basalibus 1–2, margine minute denticulatis setulosis grosse et profunde incisis; petiolo ± 1 cm. longo; stipulis glabris 1.5 cm. longis oblongo-lanceolatis apice in setam longiusculam angustatis; inflorescentiis probabiliter terminalibus paucifloris flores ♂ et ♀ gerentibus; ♂ flore immaturo: pedunculo 1.5 cm. longo; pedicello 4 mm. longo; tepalis 2 late rotundatis 7 mm. longis 9 mm. latis, staminibus in specimine valde mancis; ♀: pedunculo 1.5 cm. longo; tepalis 5 ovatis 11 mm. longis 7 mm. latis, acutiusculis; stylis 3 circiter 4 mm. longis basi 1.5 mm. connatis, apice in crura 2 circiter 1.5 mm. longa spiraliter papillosa fissis; ovario ellipsoideo 1.5 cm. longo, alis 3 membranaceis venosis subaequalibus basi apiceque ultra loculos 2 mm. productis, margine superiore truncatis basi rotundatis, 3 mm. atque 4 mm. medio latis.

NORTHEASTERN NEW GUINEA: Boana, *Clemens 41672* (TYPE), May-November 1940, alt. 750–1350 m.; Matap, *Clemens 41102*, February-April 1940, alt. 1500–1800 m.; Wantoat, *Clemens 11159*, February 1940, alt. 1200 m., bush (leaves bronze iridescent above, red-purple beneath; flowers reddish golden).

The species shows some similarity with *Begonia serratipetala* Irmsch. in the incised margin of the leaves, but it lacks the pubescence of the latter species, the inflorescence is more open, and the parts of the ♀ flower are relatively different in size.

LECYTHIDACEAE

Planchonia papuana R. Knuth, Pflanzenr. **105**(IV. 219): 56. 1939; vel aff.

NORTHEASTERN NEW GUINEA: Kajabit Mission, *Clemens 10544*, *10698*, *40652*, August-December 1939, alt. 240–600 m.

We have recorded these collections to point out that the full-grown fruit of *Clemens 10698* is 5 cm. long 4.5 cm. diameter, and filled with numerous seeds. *Planchonia* has usually few to several (2–8) seeds.

HALORAGACEAE

Haloragis chinensis (Lour.) Merr. Trans. Amer. Philos. Soc. 24(2): 290. 1935.
Gaura chinensis Lour. Fl. Cochinch. 225. 1790.

Goniocarpus scaber Koenig in Koenig & Sims Ann. Bot. 1: 547. *t. 12. f. 6.* 1805.
Haloragis scabra (Koenig) Benth. Fl. Hongk. 139. 1861.
Haloragis scabra var. *elongata* Schindl. Pflanzenr. 23(IV. 225): 29. 1905.

NORTHEASTERN NEW GUINEA: Salamau, *Clemens 40*, August 1935, alt. ± 270 m., on grassy hill trail; Wantoat (Wantot), *Clemens 10951*, January 1941, alt. 1050–1800 m. (flowers brick-purple).

Both collections cited consist of material, a part of which is in good condition and part immature or perhaps depauperate. The size of the flowers and fruits shows some variation. It may be that we have included here plants which might be designated as *H. scabra* var. *novo-guineensis* Val., but we are inclined to believe all belong to a single species.

Haloragis sanguinea sp. nov.

Frutex valde ramosus 38–45 cm. altus; ramis ± dense hirsutis; ramulis hirtellis, pilis saepe basi bulbosis; foliis subverticillatis vel oppositis, subsessilibus (petiolo vix 0.5 mm. longo) ovato-lanceolatis 2.5–5 mm. longis 1.5–2.4 mm. latis, acutis, basi rotundatis margine remote 3–5-denticulatis vel minoribus, tum integris nitidis subconcavis supra glabris vel interdum consperse pilosulis, subtus glabris vel costa saepissime parce pilosula vel verruculosa, nervis obscuris, costa tantum manifesta; inflorescentiis ad apicem caulis ramorumque; floribus in bractearum glabrarum axillis solitariis, bracteis 2.5 mm. longis lanceolatis, bracteolis 0.8–1 mm. longis circiter pedicellos aequantibus; calycis tubo 1 mm. longo, obovato, quadrangulato, 8-costato, in costis parce piloso, lobis 4 glabris ovatis 1 mm. longis acutiusculis, tubi apice adpressis vel patentibus; gompho parvo, calloso transverso; petalis 4 navicularibus 2–2.5 mm. longis apice cucullatis acutis, in dorso ad nervum pilosis; staminibus 8, filamentis brevibus, antheris 1.4–1.8 mm. longis; stigmatibus sessilibus.

NORTHEASTERN NEW GUINEA: Matap, *Clemens 11345* (TYPE), February-April 1940, alt. 1500–1800 m. (shrub; flowers dull sanguine color); Rawlinson Range, head of Bonzok River, *Clemens 41378, 41949*, May and June 1940, alt. 2100–3600 m., in open (shrub 15–18 inches high; inflorescence brick-red).

Amongst the New Guinean species of *Haloragis* J. R. & G. Forst., this shows some likeness to *H. suffruticosa* Gibbs and its varieties, in the subverticillate arrangement of the leaves. The leaves, however, are much smaller as are also the flowers in some measure. The copiously branching habit of the collections here cited suggests *H. fruticosa* F. W. Went, but here again the leaves are much smaller, shining and almost glabrous (except for the midrib on the lower surface), the habit is more compact and the flowers are slightly smaller.

PRIMULACEAE

Lysimachia japonica Thunb. var. **papuana** S. Moore, Trans. Linn. Soc. Bot. II. 9: 102. 1916.

NORTHEASTERN NEW GUINEA: Wantoat, *Clemens 10959*, January 1940, alt. 1050–1800 m.

The plant is unquestionably the same as *Brass 11425* collected at Bele River, Netherlands New Guinea. The leaves are about the same size as those described in *Lysimachia suborbicularis* Went (afterwards reduced

by van Steenis to *L. Japonica* Thunb.) or about half as large as those of the typical species. This variety was described from Netherlands New Guinea.

LOGANIACEAE

Cynoctonum Mitreola (L.) Britton, Mem. Torrey Bot. Club 5: 258. 1894.
Ophiorrhiza Mitreola Linn. Sp. Pl. 150. 1753.
Mitreola petiolata Torr. & Gray, Fl. North Amer. 2: 45. 1841.
Cynoctonum oldenlandioides (Wall.) B. L. Robinson, Proc. Amer. Acad. Arts. & Sci. 45: 396. 1910 (Contrib. Gray Herb. 38: 396).

NORTHEASTERN NEW GUINEA: vicinity of Kajabit Mission, *Clemens 40766*, August-December 1939, alt. 240–600 m.

This collection is here recorded to call attention to the validity of the generic name *Cynoctonum* J. F. Gmelin (1791) which has been adopted by most American botanists, although it seems to have been overlooked in many works on Old World species. Our material is too meager to say with definite assurance whether there is more than one widespread tropical and subtropical species, but in the material at hand we can distinguish only one species. A fuller discussion and a more complete list of synonymy is to be found in Merrill, Pap. Mich. Acad. Sci. 23: 188. 1937 (1938).

Couthovia yunzaingensis sp. nov.

Frutex vel arbor; ramulis teretibus; foliis subcoriaceis petiolatis, petiolo 0.5–1.5 cm. longo; stipulis interpetiolaribus ovatis acutis demum longitudinaliter fissis; lamina obovata 8.5–12 cm. longa, 4–6.5 cm. lata, apice obtusa vel interdum acutiuscula, basi cuneata, costa utrinque prominula, nervis lateralibus utrinsecus 4–5, utrinque prominulis oblique adscendentibus, venis inconspicuis; floribus in apice ramorum in corymbo multifloro saepius circiter 4-partito, pedunculis 1–2 cm. longis, cymae ramis primariis 3–4 cm. longis, secundariis atque tertiariis valde abbreviatis, glabris; pedicellis brevibus; sepalis 1–1.5 mm. longis, rotundatis ciliolatis basi connatis; corollae tubo 2 mm. longo extus glabro intus parte intermedia inter antheras parce pubescente, fauce dense pilosa, lobis 1.5 mm. longis acutis; filamentis brevissimis, antheris 1.5 mm. longis glabris; ovario ovoideo, stylo 1–1.5 mm. longo, stigmate capitato; fructu immaturo (abnormi?) subfusiformi, apice anguste conico basi cuneato.

NORTHEASTERN NEW GUINEA: Yunzaing, *Clemens 2346* (TYPE), April 1936, alt. 1200–1500 m.; Ogeramnang, *Clemens 4741*, *5391*, December and February 1936, 1937, alt. 1650–1770 m.; Kulungbufu, *Clemens 6617A*, July 1937, alt. ± 1650 m.

Couthovia yunzaingensis suggests *C. novo-britannica* Kaneh. & Hatus. but the flowers are larger and less densely clustered on the ultimate branches of the inflorescence, the anther-sacs are pointed rather than rounded, and the fruit, although apparently stung by insects and hence probably abnormal is much more pointed. The stipe is scarcely at all developed but we take this to be an abnormal condition in the fruit.

APOCYNACEAE

Clitandropsis Clemensiae sp. nov.

Scandens; ramulis tomentosis; foliis oppositis firme chartaceis oblongo-

lanceolatis, 10–15 cm. longis 3.5–5 cm. latis, basi obtusiusculis, apice acuminatis, acumine 1–1.5 cm. longo, supra costa pubescente excepta glabris, subtus in lamina sparse in costa dense pubescentibus, nervis lateralibus late patentibus ± remotis utrinsecus 11–14, utrinque distinctis; petiolo vix 1 cm. longo pubescente; inflorescentiis axillaribus paucifloris ± 4 cm. longis pubescentibus; bracteis oblongo-lanceolatis; pedicellis brevibus; calycis lobis lanceolatis acutis 3 mm. longis, extus sparse pubescentibus intus eglandulosis; corolla albida hypocrateriformi, tubo 1.3–1.5 cm. longo extus glabro intus versus basim excepto pubescente, lobis lineari-lanceolatis acutis ± 1.3 cm. longis, fauce squamis oppositilobis fimbriatis 3–4 mm. longis; staminibus medio tubo insertis, antheris lineari-lanceolatis 3 mm. longis, apice caudatis glabris, basi leviter curvatis; ovario 1.5 mm. longo 1 mm. lato, ovoideo glabro haud bene 2-loculato; stylo 2 mm. longo, stigmate 2.5 mm. longo bicaudato.

NORTHEASTERN NEW GUINEA: Wantoat, *Clemens 41192* (TYPE), April 1940, alt. 1200–1500 m. (flower white turning soft yellow).

This species is very close to *Clitandropsis acuta* Markgr. but the latter is glabrous and has smaller flowers.

Alyxia scabrida Markgr. Bot. Jahrb. 61: 184. 1927.

NORTHEASTERN NEW GUINEA: Kajabit, Markham Valley, *Clemens 10566*, alt. ± 600 m.

Previously known only from the type-collection.

Parsonsia Brassii Markgr. Brittonia 2: 139. 1936.

NORTHEASTERN NEW GUINEA: Ogeramnang, *Clemens 4489*, *5214*, December 1936, alt. 1800 m.; A-mieng, Yaneng River, *Clemens 12362*, July 1941, alt. 1500–1800 m.; Matap, *Clemens 41047*, February-April 1940, alt. 1500–1800 m.

Previously recorded only from the type collection, *Brass 4921,* from British New Guinea.

Parsonsia buruensis (Teysm. & Binn.) Boerl. Handl. Fl. Ned. Ind. II. 2: 397. 1899; Markgr. Bot. Jahrb. 61: 218. 1927.

NORTHEASTERN NEW GUINEA: Quembung, *Clemens 2163,* March 1936, alt. about 600 m.

Known from the Moluccas, Netherlands New Guinea and British New Guinea.

RUBIACEAE

Neonauclea Clemensiae sp. nov.

Arbor magna; ramulis crassiusculis, cortice ± ruguloso; internodiis ultimis compressis, brevibus, 1–2 cm. longis, 4–6 mm. crassis, sparsim pubescentibus vel glabris; stipulis non visis; foliis crasse papyraceis, obovatis, 18–24 cm. longis, 12–14 cm. latis, apicem versus late obtusis deinde breviter obtuse subapiculatis, basim versus angustatis deinde anguste obtusis vel interdum subauriculatis, breviter petiolatis (petiolo vix 5 mm. longo) vel subsessilibus, supra glabris, subtus lamina consperse, costa venisque dense patenti-pilosis, nervis lateralibus utrinsecus 10–12 oblique patentibus prope marginem arcuatim conjunctis, supra impressis, subtus perspicuis et prominentibus, venis subclathratis; inflorescentiis pedunculatis, pedunculo 0.5–2.5 cm. longo; capitulis 3, florentibus sine stylis ± 3 cm. diametro, sine floribus 1 cm. diametro; pedunculis secun-

dariis ± 3 cm. longis, bractearum caducarum cicatrice pubescente infra apicem vix 1 cm. munitis; calycis loborum partibus deciduis 5 mm. longis, spathulatis, parte incrassata obtuse fusiformi vel rotundato-ovoidea acutiuscula, dense pubescente, calycis parte persistente cum ovario 2 mm. longa extus glabra intus dense pubescente, ovario basi pilis sericeis circumdato; corolla tubuloso-infundibulari, 11 mm. longa, glabra; antheris in fauce; stylo fere 2 cm. longo.

NORTHEAST NEW GUINEA: vicinity of Kajabit Mission, *Clemens 10800* (TYPE), Oct. 1939, alt. about 270 m., in Markham valley bush; Sattelberg, *Clemens 990*, Nov. 1935, alt. about 900 m.

This species is apparently related to *Neonauclea reticulata* (Havil.) Merr. reported from the Philippine Islands and Formosa. The leaves are not so coriaceous, and more pubescent on the under surface; the flowers are surrounded at the base by a ring of hairs; the deciduous lobes of the calyx are smaller at the apex and more pubescent, also mostly cinereous in color.

Randia Bartlettiana sp. nov.

Arbuscula circiter 13 cm. diametro; ramulis atro-cinerascentibus vel brunnescentibus leviter sulcatis vel longitudinaliter rugulosis glabris; foliis chartaceis oblongis vel ellipticis, 10–22 cm. longis, 4–10 cm. latis, basi cuneatis, apice laesis, utrinque glabris vel subtus nervis consperse minute pubescentibus, nervis lateralibus utrinsecus 7–10 oblique adscendentibus marginem versus arcuatis, supra manifestis, subtus prominulis in axillis domatia ferentibus, venis inconspicuis; petiolo circiter 5 mm. longo, sparsim pubescente; stipulis connatis subtruncatis abrupte 4-denticulatis vel acuminatis; inflorescentiis in ramis axillaribus brevibus paniculatis, multifloris; bracteis late ovatis acuminatis intus dense hirtellis; floribus subsessilibus vel breviter pedicellatis, pedicellis 1–2 mm. longis, sparsim pubescentibus; calyce subcampanulato extus consperse minute pubescente, intus dense hirtello, pauci-glanduloso, tubo 2 mm. longo, lobis lineari-subulatis, 1.5–2 mm. longis; corolla in alabastro pubescente, tubo 2 cm. longo, fauce et inter antheras pubescentibus, lobis oblongis ± 1 cm. longis; antheris linearibus circiter 7 mm. longis, inclusis; stylo glabro, stigmaticis lobis 6 mm. longis subclavatis, ovario 2.5 mm. longo sparsim minute pubescente.

NORTHEASTERN NEW GUINEA: Boana, *Clemens 41472*, *41473*, *41856* (TYPE), May-November 1940, alt. about 900 m. (small tree 5 inches in diameter; flowers white).

This species probably belongs to the section *Gynopachys* Hook. The inflorescence and an opposite leaf appear to terminate a very short axillary or slightly supra-axillary shoot usually a single node in length. The flowers are smaller and much more numerous than those of *Randia insignis* Val. but the floral characters of *R. Bartlettiana* are somewhat similar. The calyx is densely hirtellous within, but the glands are nearer the base than those pictured for *R. insignis* Val. The corolla is pubescent outside, and the stamens inclosed although their apex is nearer the margin of the throat than in Valeton's species.

The species is named for Professor H. H. Bartlett who made this material available for study.

Gardenia invaginata sp. nov.

Planta glabra; ramulis teretibus inconspicue sulcatis; internodiis 2.5–4 cm. longis; foliis anisophyllis coriaceis ellipticis, 5–11 cm. longis, 2.2–4.5 cm. latis, basi decurrentibus cuneatis vel interdum obtusis, apice breviter acuminatis, acumine 5–9 mm. longo obtusiusculo, venis primariis utrinsecus 7–11 utrinque prominulis, subtus in axillis domatia minuta ferentibus, reticulo laxo utrinque manifesto; petiolo 0.8–1.4 cm. longo glabro; stipulis lineari-lanceolatis 1.5 cm. longis 2–3 mm. latis acutis; floribus in axillis foliorum superiorum; pedicellis brevissimis 2–4 mm. longis; calyce membranaceo spathaceo-tubulato apice lateraliter fisso longiuscule acuminato summo apice pubescente margine inflexo, 3.5 cm. longo, corollae tubo ± 7 cm. longo utrinque glabro fauce paullo dilatato, lobis 1.5 cm. longis, subovatis; antheris 6 linearibus basi angustatis 1 cm. longis, loculis circiter 8 mm. longis; stylo versus basim glabro in parte superiore hirsuto, stigmaticis lobis glabris, ovario 5 mm. longo glabro; fructu globoso circiter 2 cm. diametro, exocarpio carnoso, endocarpio lignoso vel lapideo; seminibus numerosis complanatis foveolatis ± horizontaliter placentis immersis; placentis 6.

NORTHEASTERN NEW GUINEA: Bulung River, *Clemens 5337* (TYPE), February 1937, alt. circiter 870 m.

Gardenia invaginata is closely allied with *G. Lamingtonii* F. M. Bail. In fact this is the only collection we have examined which obviously shows a sterile appendage at the base of the anther, a character given by Bailey in his original description. However, *G. invaginata* may be distinguished by the difference in the shape of the lobes of the corolla and the unribbed ovary. The collections we have taken for Bailey's species also have a pubescent throat, a feature not mentioned by Bailey.

Gardenia Clemensiae sp. nov.

Arbor alta; ramulis cinerascentibus subangularibus lenticellatis glabris; foliis plerumque anisophyllis subcoriaceis vel chartaceis glabris, ellipticis, 8–17 cm. longis, 3–7.5 cm. latis, utrinque angustatis, apice breviter acuminatis, acumine 0.5–1 cm. longo obtuso, basi anguste cuneatis vel acutis, nervis primariis utrinsecus 9–11 oblique patentibus prope marginem arcuatis, supra manifestis, subtus perspicuis in axillis domatia minuta ferentibus, reticulo denso manifesto; petiolo 1.2–3 cm. longo glabro; stipulis lanceolatis 3 cm. longis, 5–6 mm. latis, glabris, acutis; floribus axillaribus, pedicellis vix 5 mm. longis; calyce inflato-tubulato 2.5–3.5 cm. longo, 1–1.3 cm. lato, copiose venoso, apice inaequaliter lobato vel fisso, laciniis prope marginem hirtellis; corolla hypocrateriformi, tubo 12–15 cm. longo, infra medium glabro superne consperse hirtello; fauce elongata (circiter 2.3 cm. longa) intus crispe pilosa inter anthera; lobis 6, lanceolato-oblongis, 3 cm. longis, infra medium ± 1 cm. latis, apice rotundatis; antheris 2.2 cm. longis paullo exsertis; stylo basim versus glabro deorsum apicem versus (5–7 cm.) hirsuto; stigmaticis lobis glabris; ovario circiter 5 mm. longo glabro; placentis 6.

NORTHEASTERN NEW GUINEA: Sattelberg, *Clemens 1005* (TYPE), *1221*, *3108*, November, December 1935, May 1936, alt. 1500–1650 m.

One of the collections was earlier identified as *Gardenia Lamingtonii* Bail., although both have the same general habit. Here the calyx is more

inflated than in F. M. Bailey's species, the corolla tube above the middle is sparsely hirtellous outside, and the anthers are longer although the corolla tube is somewhat shorter. It is true that perhaps the anthers suggest those of Bailey's species in that the anther-sacs appear to open a little above the base of the connective although the pressed specimens do not give the impression of having a filiform appendage. It must be remembered that Bailey's descriptions were drawn up from fresh material which might appear somewhat differently when dried. *Clemens 3108* is a specimen with one fruit globose-ellipsoid, 3 cm. long, 2.5 cm. diameter, the calyx is only a remnant scarcely more than 5 mm. long.

CUCURBITACEAE

Melothria filipes sp. nov. § Eumelothria

Monoica, scandens; caulibus gracilibus, sulcatis, pubescentibus vel glabris et nodis tantum sparsim pilosis; foliorum petiolo 1.5–2 cm. longo, patenti-pilosulo; lamina tenuiter chartacea pedato-5-partita, supra scabra, subtus costa et venis patenti-pilosis, segmentis lineari-lanceolatis, margine irregulariter repandis vel consperse et inconspicue dentatis, obtusis vel acutis et mucronatis, segmento intermedio 5.5–7 cm. longis, 0.7–0.8 cm. latis, ceteris paullo minoribus, exterioribus saepe bilobatis, sinu basilari late rotundato, 3–6 mm. profundo; cirrhis gracilibus elongatis; ♂ inflorescentiis probabiliter racemosis, paucifloris, floribus immaturis; calyce 1 mm. longo, campanulato, dentibus subulatis; corolla glabra, 2 mm. longa, lobis late ovatis; staminum filamentis brevissimis, antheris subquadratis, loculis apice paullo divergentibus; ♀ floribus parvis, solitariis; pedunculis usque 4 cm. longis, filiformibus; ovario ovoideo apice attenuato; corollae lobis oblongis, fauce puberulis; stylo 1 mm. longo, basi disco annulari, stigmate capitata; fructibus globosis, ± 1 cm. diametro, glabris, seminibus obovatis, levibus, 5 mm. longis, 3 mm. latis, marginatis, margine crassiusculo.

NORTHEAST NEW GUINEA: Wantoat (Wantot), Morobe District, *Clemens 11027* (TYPE), Jan. 1940, alt. 1050–1800 m. (flowers cream-colored; fruits pink); Matap, Morobe District, *Clemens 11225A*.

BRITISH NEW GUINEA: Bella Vista, Central Division, *Brass 5449*, Nov. 1933, alt. 1450 m., twining in brush on an old garden clearing (flowers white).

Among the species of *Melothria* described previously, this seems to be most like *M. pentaphylla* Naud. from New Caledonia. The latter differs from our species in having leaves with lower surface glabrous, and fruit oblong-ovoid, with much smaller seeds.

Melothria morobensis sp. nov. § Eumelothria

Scandens; caulibus glabris, angulatis, nodis tantum minute pubescentibus; foliorum petiolo 1.5–3 cm. longo, dense et breviter hispidulo; lamina chartacea, triangulari-hastata, 4–8 cm. longa, 5–9 cm. lata, apice acuminata vel acuta, lobis basilaribus acutis vel rotundatis, margine dentatis vel subintegris, supra scabris, subtus scabriusculis et pubescentibus, pilis in nervis ± patentibus, sinu basilari usque 7 mm. profundo vel fere nullo; cirrhis glabris, gracilibus; ♂ floribus (alabastris tantum visis) ut videtur, solitariis vel 1–3 in axilla, pedunculo consperse patenti-pubescente, usque

2.5 cm. longo, gracili, calyce campanulato, 2 mm. longo, dentibus subulatis, 2.5 mm. longis; corolla pubescente; antheris late ellipsoideis, loculis rectis; ♀ floribus non visis; fructibus 3–5.5 cm. longis, vix 1.5 cm. diametro, oblongis, basi acutis, apice rostellatis; in sicco longitudinaliter pluricostatis; seminibus subobovatis, 5–6 mm. longis, 1.5–2 mm. latis, basi alato-appendiculatis.

NORTHEAST NEW GUINEA: vicinity of Kajabit Mission, Morobe District, *Clemens 10721*, Oct. 1939, alt. about 400 m., mountain bush trail; vicinity of Wantoat, *Clemens 11330 bis* (TYPE), March 1940, alt. 1050–1350 m., open woods (fruit green); Boana, *Clemens 41687*, Aug. 1940, alt. about 900 m.

This species in some characters suggests *Melothria scaberrima* Merr. but the fruit of the later is smaller and more shortly peduncled, and the leaves are of very different size and contour. Unfortunately the Papuan specimens are fragmentary, and it is difficult to say definitely whether the flowers are monoecious or dioecious, or how many grow from the axil of a leaf.

Melothria Clemensiae sp. nov.

Monoica, scandens; caulibus gracilibus, sulcatis, glabris, tantum apicibus juvenilibus et nodis pilosis; foliorum petiolo ± 1 cm. longo, crispe pilosulo; lamina submembranacea, subpellucida, angusto-triangulari, ± 6 cm. longa, 3 cm. lata, basi truncata vix sagittata, apice acuminata, margine minute et inconspicue denticulata, supra minute scabriuscula, costa basim versus pilosula, subtus levi, costa nervisque patenti-pilosis, sinu basilari nullo; cirrhis glabris simplicibus; ♂ floribus solitariis vel geminatis, ± 2 cm. pedunculatis; calyce campanulato, 3 mm. longo, lobis 1 mm. longis; corolla circiter 1 cm. longa, lobis ovatis, minute puberulis, 7 mm. longis, fauce ± dense piloso; ♀ floribus solitariis, longe pedunculatis, pedunculo 4 cm. longo, ovario 1–1.5 cm. longo, 1 mm. lato, apice 2–3 mm. attenuato; fructu non viso.

NORTHEAST NEW GUINEA: Sugu-Gaeng, Morobe, *Clemens 41287* (TYPE: Univ. Mich.), April 1940, alt. about 1050 m., wet bank of mountain trail (flowers white).

This and the preceding species have some characters in common with *M. Rauwenhoffii* Cogn. The latter, however, has glabrous leaves, and flowers about half the size of those in the Clemens' specimen.

Gynostemma pentaphyllum (Thunb.) Makino, Bot. Mag. Tokyo 16: 179. 1902.

Vitis pentaphylla Thunb. Fl. Japon. 105. 1784.

Gynostemma pedatum Blume Bijdr. 23. 1825; Harms, Bot. Jahrb. 60: 161. 1925.

NORTHEAST NEW GUINEA: Yunzaing, *Clemens 3838*, Aug. 1936, alt. about 1350 m., open hill in forest (small vine with minute whitish green flowers and green fruits).

This widespread species is recorded here only to call attention to the oldest specific epithet. The plant is ordinarily known by Blume's name.

ARNOLD ARBORETUM,
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A SURVEY OF THE PLANTS OF GUAM*

S. F. GLASSMAN

With two plates

INTRODUCTION

The purpose of this study is to group the principal plant species on Guam according to the kinds of situations most favorable for their growth, and to show the geographical distribution of each species. This survey is based, in part, on collections made by the writer in the 16 months, from 1944 to 1946, which were spent on Guam. During this period, 300 specimens of vascular plants were collected, and subsequently were sent to Dr. E. D. Merrill, Director of the Arnold Arboretum. At present, these specimens are deposited in the Arnold Arboretum and in the Herbarium of the University of Illinois. More than 29 localities, ranging from one end of the island to the other, were visited during the course of collecting. An attempt was made to collect plants in all types of situations, extending from the coral reefs to the savannas. At the same time, field notes on the flora and vegetation were made.

The second phase of this study involved a perusal of the literature dealing with the plants of Guam. Much of the information dealing with principal botanical collections, especially the earlier ones, was extracted from "The Useful Plants of Guam," by W. E. Safford, and "An Enumeration of the Plants of Guam," by E. D. Merrill. Notes on the geography of the island were obtained from the above-mentioned work by Safford. Most of the data on the names of species and their geographical distributions were taken from Merrill's enumeration, and from "An Enumeration of Micronesian Plants," by R. Kanehira. Native names of species were derived from the works of Safford and Merrill. The grouping of species is based principally on the writer's field observations and collections.

GEOGRAPHY AND CLIMATE

Guam is the largest island of the Marianas Archipelago, in the west central Pacific area. It is twenty-nine miles long, and four to nine miles wide. The island extends from 13° 14′ N. to 20° 30′ N. latitude, and from

* The writer is indebted to Dr. E. D. Merrill of the Arnold Arboretum for identification of plant specimens from Guam, and for suggestions in the preparation of this manuscript. This work has been facilitated by the valuable guidance and direction of Dr. G. Neville Jones of the University of Illinois. Thanks are also due to Dr. O. Tippo of the University of Illinois for helpful assistance in the completion of this paper, and to Mr. C. Schweinfurth of the Botanical Museum, Harvard University, for identification of certain species of Guam orchids.

143° 46′ E. to 146° 31′ E. longitude. It is therefore, approximately 1200 miles east of the Philippine Archipelago, and 3500 miles west of Honolulu. The outline of Guam may be compared roughly to the shape of a human footprint (PLATE I), with the heel north-northeast, and the toe south-southwest.

The southern half of the island is more mountainous than the northern half. Mt. Lamlam, 1334 feet above sea level (PLATE I), is the highest peak in the former region. In the valleys of the southern part of Guam, the soil is deep and black, evidently deposited by slow moving streams. The northern half of the island is a series of raised platforms of coralliferous limestone, often spoken of as the "mesa" or plateau. Mt. Santa Rosa, 870 feet above sea level (PLATE I), is the highest peak in this region. In the northern half of the island the soil is composed chiefly of heavy reddish clay, often only a few inches in depth. The subsoil in many places consists of decomposed coralliferous limestone, and below this there is a solid mass of hard coral.

All the mountain peaks are undoubtedly of volcanic origin. In some of the peaks outlines of craters can be seen. Surrounding the bases of some of the mountains are ancient coral reefs, the margins of which have been changed into crystalline limestone. This fact indicates that volcanic activity took place after the whole island was raised from the sea. On the western side, between the mesa and the ocean, there are several flat terraces showing evidence of having undergone successive upheavals. These terraces mark former sea levels, indicating that there were intervals of rest during the successive elevations of the island.

A number of rivers dissect both the central and southern portions of Guam. Near the middle of the island, about one mile and a half from Agana, is a large spring. This spring drains into a swamp which forms the Agana River (PLATE I). In the southern section of Guam, there are several small streams e.g., tributaries of the Talofofo River (PLATE I), which disappear beneath the surface of the ground, and emerge later from caverns. The northern part of the island is relatively dry because rainfall is absorbed rapidly by the coralliferous limestone. During the rainier part of the year, however, several small streams appear near the bases of hills of Mt. Santa Rosa and Mt. Mataguac (PLATE I).

The ocean bed between Midway and Guam is a vast plain approximately four miles below the surface and somewhat broken by submarine reefs and mountain ranges. When the submarine volcanic range that forms the Marianas Islands (PLATE II) is approached, this plain gradually slopes into an abyss almost six miles deep. The ocean bed between Guam and the Philippines is approximately two to four miles below the surface.

The climate is tempered throughout the year by a brisk trade wind, blowing from northeast and east. According to records of the United States Weather Bureau (14), from 1926 to 1941, the range of temperature was between 64° F. and 93° F. From 1926 to 1941 the average total annual rainfall was 91.06 inches (14). The rainfall is heaviest from July

to November, while the period of least precipitation is from December to June. September is the month of highest precipitation, with a 17 year average of 16.14 inches. April, with 2.18 inches, shows the lowest average monthly rainfall during the same period.

PRINCIPAL BOTANICAL COLLECTIONS

Since 1521, when Guam was discovered by Magellan during his circumnavigation of the earth, several botanists have explored this island. The earliest known plant collections were made in 1792 by Thaddeus Haenke and Luis Nee, botanists of the Malaspina Expedition, whose specimens were subsequently sent to the National Museum of Bohemia at Prague, and the Royal Garden at Madrid. In 1817 Adelbert von Chamisso, botanist of the Romanzoff Expedition, collected some plants on Guam, which later were deposited in the Berlin Herbarium. Charles Gaudichaud-Beaupre, with the Freycinet Expedition, collected a number of specimens on the island, but they were destroyed by sea water when his ship was wrecked on the return voyage. A. Lesson, botanist of the first D'Urville Expedition, collected some plants on Guam in 1828; but there are no records of his specimens. During the second D'Urville Expedition in 1839, J. B. Hombron collected specimens which later were sent to the Museum National d'Histoire Naturelle, Paris.

For the next sixty years no botanizing was done on Guam, but in 1899 and 1900, W. E. Safford, then Assistant Governor of Guam, collected some specimens. The results of this effort appeared under the title "The Useful Plants of Guam" (12), a work containing a list of some 350 species.

During the years 1910–1919, J. B. Thompson, Mrs. J. Clemens, R. C. MacGregor, and other botanists collected plants on Guam. Their collections formed the basis of two works by E. D. Merrill, "An Enumeration of the Plants of Guam" (8) and "Additions to the Flora of Guam" (9).

Before 1929, some 61 species of vascular plants were thought to be endemic on Guam, but when the results of the work of R. Kanehira and other botanists who collected on the Japanese mandated islands of Micronesia from 1929 to 1935 were published (6,7), it was found that twenty-nine of the supposed endemics actually occurred on other islands of Micronesia.

In 1936, E. H. Bryan collected a few hundred specimens from Guam for the Bernice P. Bishop Museum in Honolulu. From 1936–1941, he published a series of articles based on these specimens, under the title of "The Plants of Guam" (1).

Although collections have been made from Guam, further botanical exploration is needed before our knowledge of the flora of this island can be considered to be adequate. This was shown by the recent collections made by the present writer in 1946. Among 300 numbers secured, new Guam records included seventeen species in thirteen genera and three families (11).

DISCUSSION OF THE FLORA

The plants of Guam are listed under the following headings: Coral Reefs, Strand, Mangrove Swamps, Rivers and River Banks, Forests, Marshes, Grasslands and Abandoned Clearings.

No attempt has been made to include all the recorded species. However, the species that are listed, most of which the writer has collected, are the principal representatives of each of the above situations. The writer has not collected specimens of thallophytes or bryophytes, consequently, lists of these groups of plants are taken from publications of the following authors: Safford (12), algae; Graff (3), fungi and lichens; and Merrill (8), bryophytes.

A. PLANTS OF CORAL REEFS

Growing submerged in the ocean, close to the fringed coral reefs, are many species of algae and several species of flowering plants.

The green algae are represented by the following genera: *Caulerpa, Rhizoclonium, Bryopsis, Enteromorpha* and *Halimeda. Padina, Sargassum* and *Turbinaria* comprise the principal genera of brown algae. The chief representatives of the red algae are *Acanthophora, Corallopsis, Mastophora* and *Gracillaria.*

Potamogetonaceae and Hydrocharitaceae are the principal families of angiosperms found in the coral reefs. The former family is represented by *Diplanthera uninervis* (Forsk.) Aschers, extending from the Red Sea and tropical east Africa to Polynesia, and *Ruppia maritima* L., widely distributed in most warm and temperate countries. *Enhalus acoroides* (L.f.) Rich., a widely distributed species in the Indo-Malayan region, and *Halophila ovata* Gaudich., a species found only on Luzon and Guam, are the representatives of Hydrocharitaceae.

B. STRAND PLANTS

Many of the species growing along the beaches and cliffs are of extensive distribution in the tropics. Coconuts are abundant on the west coast of the island, but on the east coast, where stiff winds are blowing almost constantly, only a few of these plants occur. *Casuarina equisetifolia,* a common strand tree, grows equally well on both the east and west coasts.

According to A. W. Schimper (13), the strand plants of the Pacific Islands are divided into four formations: the "Mangrove," the "Nipa," the "Barringtonia," and the "Pes-caprae." The first category will be treated under a separate heading, "Mangrove Swamps." Nipa formation will not be included in this discussion as it is not a characteristic strand formation on Guam. The Barringtonia formation comprises the plants immediately lining the beach. Some of the more common woody species are: *Barringtonia asiatica, Heritiera littoralis, Hibiscus tiliaceus, Thespesia populnea, Ochrosia parviflora, Hernandia ovigera, Calophyllum inophyllum, Morinda citrifolia, Clerodendron inerme, Desmodium umbellatum,* and *Vitex trifolia.* The herbaceous species in this group include *Centotheca*

latifolia, Monerma repens, Thuarea involuta, Mariscus stuppeus, and *Crinum asiaticum.*

The Pes-caprae formation consists of herbaceous creepers and woody species of the beach itself. The characteristic creepers are *Ipomoea pes-caprae, I. gracilis, Canavalia lineata* and *Vigna marina.* Some of the woody species include *Scaevola frutescens, Tournefortia argentea, Pemphis acidula* and *Casuarina equisetifolia.*

Seeds and fruits of the majority of the strand plants float in salt water for a long time. In a system of classification proposed by H. B. Guppy (4), these species are divided into three groups according to structural modifications of buoyancy. The first group consists of species having air spaces in the seeds or fruits. Group two includes those species having buoyant seed coats or fruit husks. In the third group, the kernel itself is buoyant.

Group I. This group is subdivided into four sections, A. Species with air spaces between the cotyledon and seed coat, B. Those with air spaces between the cotyledons, C. Species with an air chamber in the seed, and, D. Those in which the seed partially fills the fruit cavity.

SECTION A. Lauraceae are represented by *Cassytha filiformis* L. (mayagas or dodder laurel), a climbing saprophyte which is widely distributed in the tropics of both hemispheres. The mallow family includes two species of pantropical distribution, *Hibiscus tiliaceus* L. (pago or corkwood) and *Thespesia populnea* (L.) Soland. (kilulu, quilulu). *Euphorbia atoto* Forst. f., extending from tropical Asia to Australia and Polynesia, is the representative of Euphorbiaceae in this section. The legumes contain one species of pantropical origin, *Caesalpinia crista* L. (pacao). The Rhamnaceae are represented by *Colubrina asiatica* (L.) Brongn. (gasoso), which extends from tropical Africa, Asia through Malaya to Australia and Polynesia. *Ipomoea pes-caprae* (L.) Roth (alalag-tasi), a member of the morning-glory family, is distributed in the tropics of both hemispheres.

SECTION B. This section consists of three species of leguminous plants: *Entada phaseoloides* (L.) Merr. (gaye, gayde, lodusong, bayog) and *Vigna marina* (Burm.) Merr. (akankan malulasa) are pantropical, while *Mucuna gigantea* (Willd.) DC. (akankan dangkulo) extends from tropical Asia to Polynesia.

SECTION C. *Morinda citrifolia* L. (ladda or Indian mulberry), a member of the Rubiaceae distributed from India to Polynesia, is the only species represented in this section.

SECTION D. The Sterculiaceae are represented by *Heritiera littoralis* Dry. (ufa, hufa or looking glass tree), a species extending from tropical east Africa through Malaya to Polynesia. Two species of leguminous plants fall into this section: *Desmodium umbellatum* (L.) DC. (palaga hilitai) ranges from the Mascarene Islands and tropical Asia, through

Malaya and northern Australia, and *Derris trifoliata* Lour. extends from tropical east Africa, Asia through Malaya to Australia and Polynesia.

Group II. This group is divided into two sections, A. Seeds with buoyant coats, and B. Fruits with buoyant husks.

SECTION A. *Cycas circinalis* L. (fadan, fadang), a member of the Cycadaceae, is widely distributed in the Old World tropics. The family Hernandiaceae is represented by *Hernandia ovigera* L. (nonag, nonak), a species which is distributed from Ceylon to tropical east Africa, Madagascar through Malaya to tropical Australia and Polynesia. *Excoecaria agallocha* L. (milky mangrove), a representative of the spurge family, ranges from India to Polynesia.

SECTION B. In this section, Lythraceae are represented by *Pemphis acidula* Forst. (nigas), a species extending from tropical east Africa and tropical Asia to tropical Australia and Polynesia. *Barringtonia asiatica* (L.) Kurz (puting), a member of the Lecythidaceae, occurs from tropical Asia to Polynesia. *Lumnitzera littorea* (Jack.) Voigt (nana or red flowered mangrove), a representative of the family Combretaceae, extends from tropical Asia through Malaya to Australia and Polynesia. Casuarinaceae include *Casuarina equisetifolia* L. (gago or Polynesian ironwood), a species distributed from tropical Africa to Polynesia, and pantropical in cultivation. The dogbane family contains one species in this section, namely *Ochrosia parviflora* (Forst.) Henslow (fago). This plant occurs in the Polynesian region. The family Boraginaceae includes two representatives. *Cordia subcordata* Lam., occurring from east Africa and tropical Asia through Malaya to tropical Australia and Polynesia, and *Tournefortia argentea* L.f. (hunig, hunik), ranging from tropical Asia to Mauritius, Malaya, tropical Australia and Polynesia. *Scaevola frutescens* (Mill.) Krause (nanaso), a member of the Goodeniaceae, extends from India to Polynesia. The vervain family is represented by two species, *Clerodendron inerme* (L.) Gaertn. (lodogao), distributed from India to Formosa through Malaya to tropical Australia and Polynesia, and *Vitex trifolia* L. (lagundi), extending from India to Mauritius and Japan, southward through Malaya to tropical Australia and Polynesia. Palms include two well known species, *Cocos nucifera* L. (niyog or coconut) and *Nypa fruticans* Wurmb. (nipa palm). The former plant is found in all tropical countries and is a native of some part of the Old World tropics. The nipa palm was introduced from the Philippines and occurs from India through Malaya to tropical Australia.

Group III. *Calophyllum inophyllum* L. (daog, daok or Palo Maria), a member of the Guttiferae, extends from India to tropical east Africa through Malaya to Polynesia. The leguminous plants are represented by three species. *Canavalia lineata* (Thunb.) DC. (akankan-tasi) and *Sophora tomentosa* L. are both pantropical, while *Erythrina variegata* L. (gaogao, gabgab or east Indian coral tree) is distributed from India to Polynesia. The Olacaceae in this group include the pantropical

species, *Ximenia americana* L. (piod, piut or tallow nut). The family Combretaceae is represented by *Xylocarpus granatum* Koenig (lalanyog), a species extending from India through Malaya to New Caledonia.

In addition to the strand plants with special modifications for floating, there is a number without these modifications. *Sesuvium portulacastrum* L., a member of the Aizoaceae, is found in the tropics and subtropics of both hemispheres. Utricaceae contain *Fleurya interrupta* (L.) Gaudich. (palilolia), ranging from Abyssinia to Australia and Polynesia. *Calonyction album* (L.) House (alaihai-tasi) and *Ipomoea gracilis* R. Br. (lagun, lagun tase) are examples of the Convolvulaceae in this group. The former species is pantropical in distribution, while the latter extends from tropical Asia to the Seychelles, through Malaya to tropical Australia and Polynesia. The madder family contains two species, *Bikkia mariannensis* Brongn. (gausali), found only in the Marianas, and *Oldenlandia biflora* L., distributed from tropical Asia to Polynesia. *Callicarpa paucinerva* Merr., one of the species of Verbenaceae, is known only from Guam, Rota and Saipan. *Rhoeo discolor* (L'Herit.) Hance, an example of the spiderwort family, is a native of Mexico and has been introduced in various Polynesian islands and the Philippines. The Amaryllidaceae are represented by *Crinum asiaticum* L. (piga palayi), an herb which is widely distributed in the Indo-Malayan region. Three species of strand grasses without special floating modifications are as follows: *Centotheca latifolia* (Osbeck) Trin., *Monerma repens* (Forst.) Beauv. (las-aga) and *Thuarea involuta* (Forst. f.) R. and S. (las-aga). The first plant extends from tropical Asia and Africa through Malaya to Australia and Polynesia; the second one is distributed from Ceylon to Australia and Polynesia, while the last ranges from Malaya to Polynesia. *Fimbristylis cymosa* R. Br. var. *umbello-capitata* (Mann.) Hillebr., found only in Guam and the Hawaiian Islands, and *Mariscus pennatus* (Lam.) Merr., extending from tropical Africa to southeastern Asia, Malaya and Polynesia, are the sedges included in this group.

C. PLANTS OF MANGROVE SWAMPS

At the mouth of many tidal streams where the water is brackish and the shores are muddy, mangrove trees extend far out into the water. The descending water of the rivers is stopped temporarily when it meets tide-water, and then deposits its sediment in the form of broad mud flats or deltas. On these deltas the trees forming the mangrove forest find conditions favorable for their development since the fruits or seedlings of these species are transported by salt water. This forest is usually free from undergrowth. The principal species are characterized by the presence of specialized, aerial roots, such as knees, high prop roots, or enlarged roots. At extreme low tide, when the mud flats are not covered with water, these roots give a distinctive appearance to the vegetation.

Trees of the family Rhizophoraceae are the most conspicuous species of the mangrove swamps. *Rhizophora apiculata* Bl. (mangle hembra) and *R. mucronata* Lam., distributed along the tropical shores of the Old World,

are the first species to seed and occupy newly formed mud flats. They are prop-rooted species which grow in the portion of the swamp most deeply flooded by the tides. *Bruguiera conjugata* (L.) Merr. (mangle macho), a tree with root knees, extends from tropical Asia and Africa through Malaya to tropical Australia. This species occupies the inland portion of the swamp which is barely flooded at high tide.

In addition to the species already mentioned, there are several strand plants occurring along the inner edges of these salt water swamps. These strand species include *Xylocarpus granatum*, *Excoecaria agallocha*, *Lumnitzera littorea* and *Heritiera littoralis*.

D. PLANTS OF RIVERS AND RIVER BANKS

The genera of algae growing below the surface of many streams include *Conferva*, a representative of the green algae, *Chara*, a member of the Characeae, and *Thorea*, one of the red algae. All the submerged species of flowering plants fall into the family Potamogetonaceae. *Potamogeton mariannensis* Cham. and Schlecht., found only on Guam, is a fresh water species, while *Ruppia maritima* grows also in brackish water and sea water. Near the mouth of many streams where the water is brackish, *Nypa fruticans* grows in abundance. This palm, which grows partially immersed in water, usually extends up these rivers for a great distance. *Eichhornia crassipes* (Mart. and Zucc.) Solms-Laubach (water hyacinth), a native of the subtropics of America, is a floating species of the pickerel-weed family. *Ipomoea aquatica* Forsk. (cancon), a plant widely distributed throughout the Old World tropics, creeps along the surface of many streams.

Several species of ferns grow along river banks. *Angiopteris evecta* (Forst. f.) Hoffm., a member of the Marattiaceae, ranges from Micronesia to Polynesia. The Hymenophyllaceae are represented by *Trichomanes javanicum* Bl., a plant extending from tropical Asia to the Ryukyu Islands southward to Australia and Polynesia. A very rare, endemic species of tree fern is *Cyathea haenkei* (Presl) Merr. This plant grows in shady places along mountain streams. Polypodiaceae are represented by *Acrostichum aureum* L. (langayao), a species of pantropical distribution, and the endemic *Dryopteris depauperata* Copel.

In addition to the ferns listed above, there are a few angiosperms which commonly grow along the banks of streams. These include *Hibiscus tiliaceus*, a typical strand plant, and *Areca catechu* L. (pugua or betel nut palm), widely distributed in the Indo-Malayan region.

E. FOREST PLANTS

The plants of the forests are classified into trees, shrubs, epiphytes, lianas, and ground cover plants. Trees, epiphytes and lianas are the most abundant, while shrubs and ground cover plants are poorly represented in both number of species and in number of individuals. None of the areas in the Guam forests is dominated by any single species or by small groups of

species. Generally, ten or more species of trees grow side by side in approximately equal abundance. Most of the woody plants are evergreen, but *Pisonia grandis*, a common forest tree is deciduous. The trees are represented by a diversified group of families and species. Annonaceae contain two common species which are native to tropical America, and cultivated in most tropical countries. These include *Annona muricata* L. (laguana or soursop) and *A. squamosa* L. (atis or sweetsop). *Cananga odorata* (Lam.) Hook.f. and Th. (alangilang), another member of this family, and widely distributed in the Indo-Malayan and Polynesian regions, is less common than the other two species. Nyctaginaceae are represented by *Pisonia grandis* R. Br. (umumu), a species extending from the Philippines, Moluccas, northeastern Australia across Polynesia to the Palmyra Islands. *Xylosma nelsonii* Merr., only found in Guam and Rota, and *Pangium edule* Reinw. (raual), of wide distribution in the Malayan region, are examples of the family Flacourtiaceae. The myrtle family contains three species of restricted geographical distribution. These include *Eugenia reinwardtiana* DC. (aabang), *E. palumbis* Merr. and *E. thompsonii* Merr. All except the first, which is found in the Carolines and Moluccas, occur only in the Marianas. *Elaeocarpus joga* Merr. (joga), distributed only in the Marianas, is a member of the Tiliaceae. Two representatives of the spurge family which do not extend beyond the Marianas, are *Claoxylon mariannum* Muell.-Arg. (panao) and *Macaranga thompsonii* Merr. *Artocarpus communis* Forst. (dugdug, dugdog or bread fruit), a species cultivated in many tropical countries, and *Pseudomorus brunoniana* (Endl.) Bur., of wide distribution in Polynesia, Australia and New Guinea, are examples of the family Moraceae. Other members of this family include the endemic *Ficus mariannensis* Merr. (nunu) and *F. tenuistipula* Merr., a species also found in Saipan. The nettle family is represented by *Pipturus argenteus* (Forst. f.) Wedd. (amahadyan), extending from Malaya to Polynesia. *Aglaia mariannensis* Merr. (mapunao) and *Disocalyx megacarpa* Merr., representatives of the Meliaceae and Myrsinaceae, respectively, are found only in the Marianas. Loganiaceae are represented by *Fagraea sair* Gilg & Benedict which also is found in the Carolines. Examples of the Rubiaceae include two species known only to the Marianas, *Tarenna glabra* Merr. and *Psychotria mariana* Bartl. (aplochating). Other members of this family include *Ixora triantha* Volkens, otherwise only known to Yap, and *Randia racemosa* (Cav.) F.-Vill. (sumac, sumag), ranging from the Ryukyus and southern China to Malaya and tropical Australia. Representatives of the screw-pine family are *Pandanus kafu* Martelli (kafu, kafo), known only to Guam and Saipan, and *P. dubius* Spreng. (pahong, pahon), distributed from India to the Carolines and Marianas southward to New Hebrides. In addition to the trees already mentioned, there is a number of strand trees which are characteristic of the forests. These species are *Cycas circinalis, Hernandia ovigera, Hibiscus tiliaceus, Ochrosia parviflora, Morinda indica, Cordia subcordata* and *Ximenia americana.*

As previously mentioned, the forest shrubs are poorly represented on Guam. Piperaceae contain one endemic species, *Piper guahamense* C. DC. (pupulo aniti). *Guamia mariannae* (Safford) Merr., a member of the family Annonaceae, is known only to the Marianas. *Triphasia trifolia* (Burm. f.) P. Wils. (limon de China, lemoncito), an example of the rue family which is widely distributed in the tropics of the Old World, forms thickets on the edges of forests. The spurge family contains *Glochidion marianum* Muell.-Arg. (chosgo, chosgu), a species otherwise known only to Samoa and Tonga. *Merrilliodendron rotense* Kanehira, a member of the family Icacinaceae, is found only on Guam and Rota.

Even though the vascular epiphytes are extremely abundant, there are only a few families represented. Polypodiaceae contain a number of species which are widely distributed in the Old World tropics. *Antrophyum plantagineum* (Cav.) Kaulf., *Cyclophorus lanceolatus* (L.) Alst. and *Vittaria elongata* Sw., extend from tropical Asia to Polynesia. Two examples of *Asplenium* are *A. laserpitifolium* Lam., and *A. nidus* L. (galak, galag or bird's nest fern). The former species is distributed from Malaya to Australia and Polynesia, and the latter one ranges from Himalaya, Japan, Formosa, eastward to the Society Islands. *Nephrolepis biserrata* Schott is pantropical, *Davallia solida* (Forst. f.) Sw. (pugua machena) is distributed from Malaya to northern Australia and Polynesia, and *Humata heterophylla* (Sm.) Desv. is found in Malaya and Polynesia. *Polypodium* is represented by *P. punctatum* (L.) Sw., extending from tropical Africa, Asia through Malaya to Polynesia, and *P. scolopendria* (kahlau) Burm.f., which is distributed from tropical Africa and Asia to Australia and Polynesia. The endemic species of orchids are *Bulbophyllum guamense* Ames, *Dendrobium guamense* Ames, *Saccolabium guamense* Ames and *Taeniophyllum fasciola* (Forst. f.) Reichb. f. (kamuke nanofe). In addition to the orchids mentioned above, two species of *Phreatia* are found, *P. thompsonii* Ames, also known from the Carolines, and *P. samoensis* (Kranzl.) Schlechter.

In some sections of Guam the lianas are so numerous as to make passage impossible. The most abundant species is *Flagellaria indica* L. (bejuco halomtano), a member of the Flagellariaceae which extends from tropical Asia to Malaya. The screw-pine family is represented by *Freycinetia mariannensis* Merr. (fianiti), a species known only to the Marianas. *Abrus precatorius* L. (kolales halom-tano or coral bead vine), an example of the legume family, and *Ipomoea hederacea* (L.) Jacq., one of the morning glories, are both pantropical. Another member of the morning glory family is *Ipomoea indica* (Burm.) Merr. (fogfu), distributed from Formosa to the Moluccas, tropical Australia and Polynesia. A representative of Cucurbitaceae is *Melothria guamensis* Merr., also known from Ponape and Saipan. The milkweed family contains the endemic species, *Dischidia puberbula* Decne., and the Apocynaceae are represented by *Alyxia torresiana* Gaudich., found only in the Marianas. *Morinda glandulosa* Merr., also known from Saipan, is an example of the madder family.

Cassytha filiformis, *Entada phaseoloides* and *Mucuna gigantea*, characteristic strand lianas, are usually found along the outskirts of forests.

Generally, the forests are not matted with undergrowth to any great extent, except where the trees are few in number. The species comprising the ground cover are usually confined to the forests, but they often extend to the strand, marshes and waste places. Polypodiaceae are represented by *Asplenium macrophyllum* Sw., ranging from India to the Mascarene Islands and Polynesia, *Dryopteris didymosora* (Parish) C. Chr., occurring in the warmer parts of both hemispheres, and *Tectaria crenata* Cav., widely distributed in Malaya. *Peperomia guamana* C. DC. (podpod palauan), an endemic species, is a member of the Piperaceae. The nettle family contains *Procris pedunculata* (Forst. f.) Wedd., extending from Malaya to Polynesia. *Polyscias grandifolia* Volkens, known only from the Marianas and Carolines, and *Alocasia macrorrhiza* (L.) Schott, widely distributed in the Indo-Malayan region, are representatives of the Araliaceae and Araceae, respectively. *Tacca pinnatifida* Forst. (gabgab, gaogao or Polynesian arrowroot), an example of the Taccaceae, ranges from tropical Africa and Asia through Malaya to Australia. The ginger family contains *Zingiber zerumbet* (L.) Sm. (asngod halomtano or wild ginger), a native of tropical Asia which is distributed in the tropics of both hemispheres. *Canna indica* L. (mango halom tano), a member of Cannaceae, is pantropical.

According to Graff (3), the following genera of fungi are attributed to Guam: *Phyllachora*, *Auricularia*, *Hirneola*, *Polyporus*, *Fomes*, *Polystictus*, *Trametes*, *Hexagonia*, *Laschia*, *Schizophyllum*, *Lentinus*, *Coprinus*, *Naucoria*, *Phoma*, and *Cladosporum*. The same author also lists the following genera of lichens: *Pseudopyrenula*, *Bottaria*, *Arthonia*, *Graphis*, *Coenogonium*, *Lecidia*, *Leptogonium*, *Pannaria*, *Coccocarpia*, *Pertusaria*, *Parmelia*, *Romalina*, *Physcia*, *Anaptychia*, and *Rhipodonema*.

Merrill (8) has listed a number of bryophytes. The liverworts include: *Frullania*, *Dicranolejeuna*, *Radula*, and *Thysananthus*. *Neckeropsis*, *Macromitrium*, *Syrrhopodon*, *Thuidium* and *Ectropothecium*, comprise the genera of mosses.

F. MARSH PLANTS

In the southern portion of the island, near the towns of Piti and Agate (PLATE I), there is a number of low, damp areas in which marsh plants grow. The Agana marsh in the central section of Guam is the largest marshy area on the island. During the rainier part of the year several small marshes appear in the Mt. Santa Rosa region.

Phragmites karka (Retz.) Trin. (karriso), one of the grasses extending from India to Malaya, is the most abundant marsh plant. Other members of the grass family include *Bambusa vulgaris* Schrad. (pio paloan), *Echinochloa colonum* (L.) Link (chaguan agaga), *Paspalum conjugatum* Berg., and *P. orbiculare* Forst. All the mentioned species except the last one, which is found in the Indo-Malayan region, are pantropical.

Cyperaceae are represented by *Cyperus difformis* L., *Fimbristylis annua* (All.) R. and S., *F. miliacea* (L.) Vahl, and *Scleria lithosperma* (L.) Sw. *Fimbristylis annua* is also known from the Carolines, while the other species are widely distributed in the tropics of both hemispheres. *Polygonum barbatum* L. (Mamka) ranging from tropical Asia to Malaya, is an example of the buckwheat family. The families Umbelliferae and Scrophulariaceae each contain one species of pantropical distribution, while the legume family is represented by a species of extensive distribution in the Old World Tropics. These species include *Centella asiatica* (L.) Urban, *Bacopa monniera* (L.) Wettst. and *Aeschynomene indica* L., respectively. *Psilotum nudum* (L.) Griseb., a member of the Psilotaceae, extends to the tropics of both hemispheres. Schizaeaceae is represented by *Lygodium scandens* (L.) Sw. (alambrillo), occurring from tropical Africa and Asia to Australia. *Dryopteris gongylodes* (Schkuhr) O. Ktze. and *Acrostichum aureum,* both pantropical plants, are members of the Polypodiaceae.

G. PLANTS OF GRASSLANDS

There are two distinct kinds of grasslands on Guam, savannas and "microsavannas." Savannas are grassy upland regions with scattered trees and shrubs. The soil in these regions is poorly drained, and is deficient in organic matter. Many mountain areas on the southern end of the island e.g., Mt. Tenjo (PLATE I), support a savanna type of vegetation.

The microsavannas differ from the savannas by the absence of woody species characteristic of the latter. Besides this, in the microsavanna regions the soil is rich in nitrates, and is well drained. The most pronounced microsavanna regions are around the vicinity of Mt. Santa Rosa. Some plants, such as *Miscanthus floridulus, Paspalum orbiculare, Fimbristylis annua, Lygodium scandens, Schizoloma ensifolium* and *Melastoma marianum,* occur in both kinds of grasslands.

Casuarina equisetifolia, a typical strand plant, is the only tree found in the savannas. Shrubs are represented by several species which are few in numbers of individuals. *Melochia villosissima* (Presl) Merr. and *Timonius nitidus* (Bartl.) F.-Vill., are endemic members of the Sterculiaceae and Rubiaceae, respectively. The myrtle family contains *Decaspermum fruticosum* Forst., extending from India and China through Malaya to tropical Australia, and *Myrtella bennigseniana* (Volkens) Diels, known only from Guam and Yap. *Geniostoma micranthum* A. DC., an example of the Loganiaceae, is known only from the Marianas. Thymelaeaceae is represented by *Wikstroemia elliptica* Merr., found only in the Marianas and the Carolines. *Melastoma marianum* Naud., occurring in the Marianas and the Carolines, is a member of the Melastomataceae. In addition to the shrubs mentioned above, two strand plants occur, *Pemphis acidula* and *Scaevola frutescens.*

The most abundant plant in the savannas is *Miscanthus floridulus* (Labill.) Warb. (neti, tipun-neti), a grass which is distributed from Formosa to Australia and Polynesia. Other members of the grass family are

the endemic *Dimeria chloridiformis* (Gaudich.) K. Schum. & Lauterb., *Centotheca latifolia* (Osb.) Trin., extending from tropical Asia and Africa through Malaya to Australia and Polynesia, and *Andropogon fragilis* R. Br., found in the Philippines, southern China, New Guinea, and in tropical Australia. *Cladium gaudichaudii* W. F. Wright, known only to Guam and the Carolines, *Rhynchospora rubra* (Lour.) Makino, ranging from tropical Africa and Asia to Japan southward to Australia and Polynesia, and *Scleria lithosperma,* are representatives of Cyperaceae. An example of the lily family is *Dianella ensifolia* (L.) DC., occurring from India to Malaya and Polynesia. Amaryllidaceae includes *Curculigo orchioides* Gaertn., extending from India to Malaya. *Phyllanthus saffordii* Merr., known only to Guam, and *Euphorbia vachellii* H. & A., ranging from southern China to Malaya and tropical Australia, are examples of the spurge family. The composite family is represented by *Glossogyne tenuifolia* Cass., occurring from southern China and Formosa southward to Australia, and *Wedelia canescens* (Gaudich.) Merr. (masigsig chunge), known only to the Marianas. *Psilotum nudum,* a member of the Psilotaceae, and *Lycopodium cernuum* L., an example of the Lycopodiaceae, are both pantropical. *Gleichenia linearis* (Burm. f.) Clarke (mano), found in the warmer parts of both hemispheres, is a representative of Gleicheniaceae. Members of the Polypodiaceae include *Blechnum orientale* L. and *Cheilanthes tenuifolia* (Burm. f.) Sw., both ranging from tropical Asia to Polynesia; *Dryopteris cucullata* (Bl.) Christ is distributed from the Mascarene Islands to Malaya; and *Schizoloma ensifolium* (Sw.) J. Sm. extends from tropical Africa and Asia to Polynesia.

As in the savannas, the most abundant plant in the microsavannas is *Miscanthus floridulus.* Other species of grasses found in the microsavannas include *Andropogon aciculatus* Retz., occurring from India to China southward through Malaya to tropical Australia, and *Paspalum conjugatum.* The sedges are represented by *Mariscus cyperinus* (Retz.) Vahl, distributed from tropical Asia to Polynesia, and *Fimbristylis miliacea. Eulophia guamensis* Ames, an endemic orchid, also occurs in these regions. Polypodiaceae are represented by *Nephrolepis hirsutula* (Forst. f.) Presl, extending to the tropics of both hemispheres. Several common weeds are occasionally found in the microsavannas. *Hyptis capitata* Jacq. (batunes, botones), one of the mints native of tropical America, is known in the orient from the Philippines, Formosa, Java and Amboina. Acanthaceae and Compositae are represented by *Blechum pyramidatum* (Lam.) Urb. and *Elephantopus mollis* HBK., respectively. Both species are native of tropical America, and are also known in the Orient from the Philippines, Formosa and Celebes.

H. PLANTS OF ABANDONED CLEARINGS

These areas are usually overgrown with common tropical weeds, escaped cultivated plants and indigenous species. Herbs, especially annuals, dominate these artificial areas; however, several species of shrubs and small

trees, such as *Triphasia trifolia, Jatropha curcas, Melanolepis multiglandulosa, Melochia odorata, Cestrum nocturnum* and *Carica papaya,* form thickets. In recently cleared fields, the papaya is able to gain a foothold and dominate the area to an extent that many other species of plants are excluded.

The species growing in abandoned clearings are classified into three groups, those definitely or probably native of the Old World, those definitely or probably native of the New World, and lastly, species of uncertain origin.

Representatives of the first group are as follows: *Achyranthes bidentata* Bl. (chichitun), *Oxalis repens* Thunb. (agsom, apsom), *Luffa cylindrica* (L.) Roem. (pachodag), *Corchorus acutangulus* Lam. (masigsig lahe), *Melochia odorata* L. f., *Abutilon indicum* (L.) Sweet (malbas, matbas or Indian mallow), *Melanolepis multiglandulosa* (Reinw.) Reichb. (alom, alum), *Phyllanthus marianus* Muell.-Arg., *Ricinus communis* L. (agaliya or castor bean), *Alysicarpus vaginalis* (L.) DC., *Crotalaria quinquefolia* L. (cascabeles), *Dolichos lablab* L., *Oldenlandia corymbosa* L., *Emilia sonchifolia* (L.) DC., *Glossogyne tenuifolia, Sonchus oleraceus* L., *Heliotropium ovalifolium* Forsk., *Merremia gemella* (Burm. f.) Hallier f. (nyetcor), *M. hederacea* (Burm. f.) Hallier f., *Digitaria stricta* Gaudich., *Oplismenus undulatifolius* (Ard.) Roem. and Schult., *Panicum ambiguum* Trin., *Pennisetum polystachyum* (L.) Schult., and *Thuarea involuta.*

Natives of the New World include: *Amaranthus spinosus* L. (kuletes), *Boerhaavia diffusa* L. (dafau or glue weed), *Passiflora foetida* L. var. *hispida* (DC.) Killip, *Carica papaya* L., *Psidium guajava* L. (abas or guava), *Muntingia calabura* L., *Triumfetta semitriloba* Jacq. (dadangsi), *Waltheria americana* L. (matico), *Malachra capitata* L. (pagopago), *Euphorbia heterophylla* L. (poinsettia), *Jatropha curcas* L. (tubatuba or physic nut), *Cassia occidentalis* L. (mumutun sable, negro coffee or coffee senna), *C. tora* L. (amottomaga), *Calopogonium mucunoides* Desv., *Crotalaria mucronata* Desv., *Leucaena glauca* (L.) Benth. (tangantangan), *Asclepias curassavica* L. (Curacao milkweed), *Mitrocarpum hirtum* (L.) DC., *Ageratum conyzoides* L., *Elephantopus mollis, Synedrella nodiflora* (L.) Gaertn., *Heliotropium indicum* L. (berbena), *Capsicum frutescens* L. (doni or Cayenne pepper), *Cestrum nocturnum* L. (dama de noche), *Datura metel* L. (las doce), *Lycopersicon esculentum* Mill. (tomate or tomato), *Physalis angulata* L., *Ipomoea triloba* L., *Quamoclit pennata* (Desr.) Boj. (cebello del angel or cypress vine), *Blechum pyramidatum, Stachytarpheta jamaicensis* (L.) Vahl, *Hyptis capitata, H. mutabilis* (A. Rich.) Briq., *H. spicigera* Lam., *H. suaveolens* Poir., *Cenchrus echinatus* L., and *Chloris inflata* Link.

Species of uncertain origin are *Polanisia icosandra* (L.) W. and A. (mongos paloma), *Portulaca oleracea* L., *Momordica charantia* L. (almagoso or balsam pear), *Sida acuta* Burm. f. (escobilla adumelon), *S. rhombifolia* L. (escobilla dalili), *Urena lobata* L. (dadangsi, dadansi), *Acalypha indica* L., *Euphorbia hirta* L. (golondrina), *Desmodium triflorum* (L.)

DC. (agsom, apson), *Teramnus labialis* (L.f.) Spreng. (chaguan cacaguates), *Adenostemma lavenia* (L.) O. Ktze., *Solanum nigrum* L., *Dactyloctenium aegyptium* (L.) Richt. (Egyptian grass), *Eleusine indica* (L.) Gaertn. (umog), *Eragrostis amabilis* (L.) W. and A., *Setaria verticillata* (L.) Beauv., and *Cyperus rotundus* L.

GEOGRAPHICAL DISTRIBUTION OF SPECIES

The flora of Guam is essentially Malayan. Nearly all the indigenous genera found there are of wide Indo-Malayan distribution.

There are 66 species endemic to the Marianas. Certain species, such as *Lygodium semihastatum* (Cav.) Desv., *Halophila ovata* and *Bulbophyllum profusum* Ames, are confined to Guam and the Philippines. Some other species, *Ixora triantha* Volkens and *Myrtella benningseniana*, occur only on Guam, and the island of Yap in the Carolines. More than eighty per cent of the species found on Guam also occur in the Philippines, and nearly the same percentage of species extend to the Carolines.

According to Hosokawa (5), the floras of the Bonins and the Marianas show a marked phytogeographical discontinuity. The flora of the Bonins forms a transition zone between temperate east Asia and Micronesia, showing a closer relation with the former. On the other hand, the flora of the Marianas is principally tropical, and therefore has not been influenced by floristic elements migrating from temperate east Asia. There are no species of plants found exclusively in these two groups of islands. Certain families common to the Marianas, such as Taccaceae and Casuarinaceae, apparently have never been found in the Bonins.

According to the writer's recent tabulations, approximately 510 species (excluding species of cultivated plants), belonging to 455 genera and 100 families of vascular plants have been listed for Guam. Pteridophytes are represented in this list by 47 species belonging to 27 genera and 11 families. There is only one gymnosperm, *Cycas circinalis*. The remainder consist entirely of angiosperms.

There are no endemic genera, and only 32 endemic species on Guam. The latter number is about seven per cent of the total recorded species, and is surprisingly small when one considers the isolated position of the island. In the Philippine Islands, which are much closer to the continental land mass, sixty eight per cent endemism exists (10), and in the Hawaiian Islands more than eighty-five per cent of the species are endemic to that region (2). The low percentage of endemism on Guam can be explained by the fact that the island is geologically recent, and that extensive destruction by man of the original vegetation has exterminated some of the endemics.

More than one-half of the total number of species are of pantropical distribution. It is impossible to determine in which hemisphere twenty per cent of these pantropical species originated because of their universal abundance, and because of absence of early records. Of the remainder,

however, forty per cent are definitely or probably of American origin, and forty per cent probably originated in the eastern hemisphere.

INTRODUCED AND NATURALIZED SPECIES

According to Merrill (8), the period during which foreign species were brought to Guam, can be divided into four subdivisions of time. In the first or prehistoric period, the Chamorros, who were the aboriginal inhabitants, brought some of their food plants, such as breadfruit, yams, coconuts, bananas and rice from Malaysia, or from Polynesia. Undoubtedly some weeds of wide Indo-Malaysian distribution such as *Glossogyne tenuifolia*, *Merremia gemella* and *M. hederacea*, reached the island at the same time.

The second period extends from the discovery of the island by Magellan in 1521 to the discontinuance in 1815 of the voyages of the Spanish galleons from Acapulco, Mexico, to Manila via Guam. The plants introduced in this era were mainly of American origin, e.g., sweet potato, corn, tobacco, cocoa, peanut, tomato, cassava and papaya. At the same time many weeds of American origin, such as *Mitrocarpum hirtum*, *Ipomoea triloba* and *Elephantopus mollis*, were introduced. It is believed that a number of weeds of oriental origin made their appearance from Manila, for economic plants such as coffee, tamarind, mango, nipa palm and some citrus fruits were also brought in.

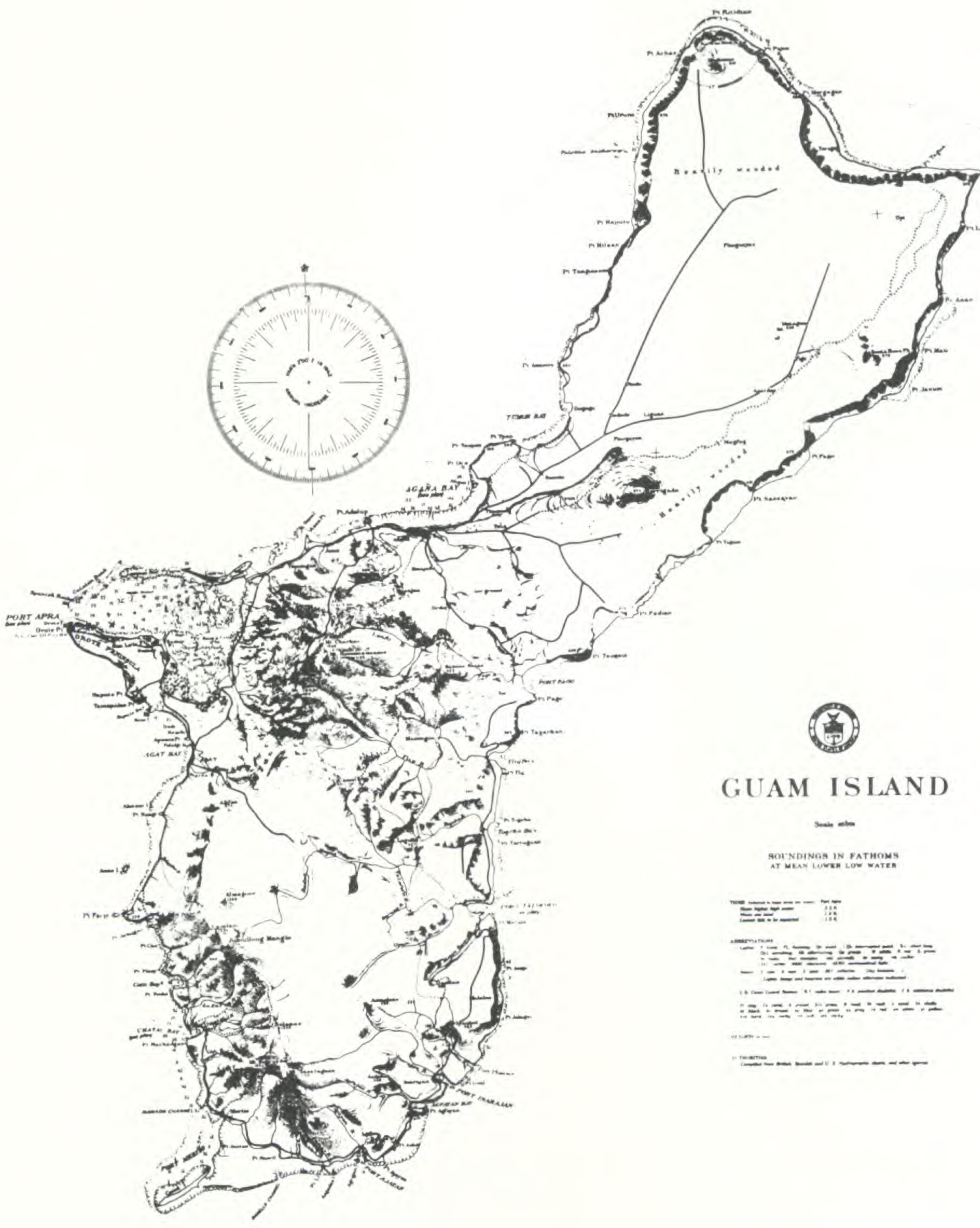
During the third period, from 1815 to 1898, when the visits of the Spanish galleons ceased, and Spain lost control of Guam and the Philippines, relatively few new plants reached the island.

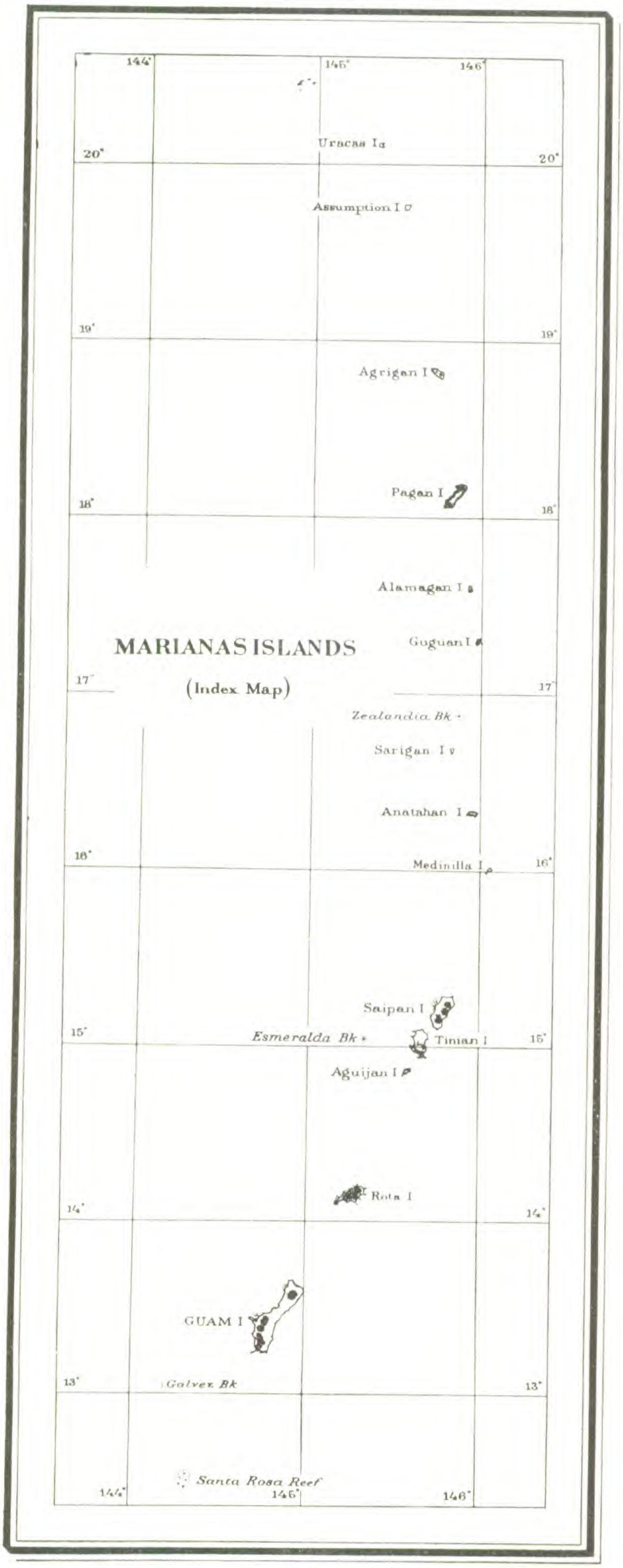
The last period dates from the American occupation in 1898 to the present time. Ornamental species from Hawaii, such as *Carissa grandiflora* (E. Mey.) A.DC. and *Tabernaemontana divaricata* (L.) R. Br., were introduced during this time. According to new records based on the writer's collection (11), several weeds of New World origin, including *Eichhornia crassipes*, *Passiflora foetida* var. *hispida*, *Calopogonium mucunoides*, and *Chloris inflata*, and one weed species of Old World origin, *Sonchus oleraceus*, has been introduced recently.

SUMMARY

Although there has been a number of collections made from Guam, further botanical exploration is needed before the flora of this island can be thoroughly understood. That this is true is attested by the fact that the writer in 1946 was able to add new Guam records of 17 species among 300 numbers.

The plants of Guam are grouped under the following headings: Coral Reefs, Strand, Mangrove Swamps, Rivers and River Banks, Forests, Marshes, Grasslands, and Abandoned Clearings. The flora of Guam is essentially Malayan, and most of the indigenous genera are widely distributed in the Indo Malayan region. Certain species are known only from Guam and the Philippines, and some other species are confined to Guam and Yap. The floras of the Marianas and the Bonins show a marked phytogeographical discontinuity.


Heavily wooded
PORT APRA
AGANA BAY
GUAM ISLAND
SOUNDINGS IN FATHOMS
AT MEAN LOWER LOW WATER


144°
146°
146°
20°
Uracas I
20°
Assumption I
19°
19°
Agrigan I
18°
Pagan I
18°
Alamagan I
MARIANAS ISLANDS
Guguan I
17°
(Index Map)
17°
Zealandia Bk
Sarigan I
Anatahan I
16°
Medinilla I
16°
Saipan I
15°
Esmeralda Bk
Tinian I
15°
Aguijan I
Rota I
14°
14°
GUAM I
13°
Galvez Bk
13°
Santa Rosa Reef
144°
145°
146°

According to the writer's recent tabulations, 510 species, belonging to 455 genera and 100 families of vascular plants, have been listed for Guam. Considering its isolated position, the island has a low percentage of endemic species. This can be explained by the fact that Guam is of recent geological origin, and that extensive destruction by man of the original vegetation has exterminated some of the endemics.

More than half of the total number of species are distributed in the tropics of both hemispheres. It is impossible to determine in which hemisphere 20 per cent of these pantropical species originated, while 40 per cent are of American origin, and 40 per cent originated in the eastern hemisphere.

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EXPLANATION OF PLATES

Plate I. Guam Island showing the various localities mentioned (U. S. Coast and Geodetic Survey).

Plate II. Marianas Islands showing relative position and size of Guam (U. S. Coast and Geodetic Survey).

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AN OVERLOOKED FLORA INDICA

E. D. MERRILL

With one plate

IN JANUARY, 1947, Mrs. C. G. G. Van Steenis, who was checking various references in the library of the Arnold Arboretum, called my attention to Pennant's *Flora Indica* which forms a part of the fourth volume of that author's *Outlines of the Globe*, published in London in 1800. We had never seen any reference to Pennant's work, and a later check of the literature indicated that this *Flora Indica* had been consistently overlooked by botanists. It is not included in Pritzel's *Thesaurus* (1872), nor is it listed in Jackson's *Guide to the Literature of Botany* (1881). The only reference to the work that has been noted is in Rehder's *Bradley Bibliography* 1: 536. 1911, where the Pennant *Flora Indica* is listed, and in 3: 274. 1915, where the fourth volume of Pennant's work is included under its secondary title. Apparently Rehder did not realize that he was dealing with an item that had been thoroughly overlooked by his predecessors. In the vast botanical literature appertaining to British India I do not remember ever having seen a reference to this work.

In June, 1947, I noticed a manuscript *Flora Indica* offered at a very modest price by a London dealer, its author unknown. The catalogue entry was: "Flora Indica.-MS. List of Plants and Flora of Coromandel. Neatly written in a late 18th cent. hand on 145 pages, folio, with index." On the chance that it might prove to be of some interest it was ordered for the Arnold Arboretum library. The manuscript was received on August 7, 1947, there being a pencilled annotation on the inside of the cover "T. Pennant's copy." This is apparently Pennant's signature; the emendations and additions in pencil, in the manuscript, are in the same handwriting. The copy, clearly a preliminary one, was manifestly prepared by an amanuensis, and is remarkably well done. There are minor differences here and there, as between the manuscript and the published text, as certain references were eliminated, others added, and occasional changes made in the discussions. It is a remarkably strange coincidence that just as this paper was being completed we should acquire a copy of the original hand written document that formed the basis of the *Flora Indica* here discussed, the publication of which had been overlooked by all botanists for nearly a century and a half.

Thomas Pennant (1726–1798) was essentially a zoologist, publishing extensively in that field. Britten and Boulger, *Index of Deceased British and Irish Botanists*, ed. 2, 240. 1931, characterize him as a zoologist and antiquary. He is also the author of certain books on travel in Scotland,

Wales, and England, and a description of London. Some of his works were issued in several editions. His projected *Outlines of the Globe** was apparently an extensive work, of which, however, only four volumes were published. He states in the opening sentence of the advertisement, volume one, p. i, that: "These Two Volumes are composed from the XIVth and XVth of my Outlines of the Globe." Volumes three and four were issued after his death under the editorship of his son, David Pennant.

All of the volumes of Pennant's work carry the title page *Outlines of the Globe,* but each has a second title page, that of volumes one and two being *The View of Hindoostan,* the first appertaining to western, the second to eastern Hindustan. The second title page of volume three is *The View of India Extra Gangem, China, and Japan,* while that of volume four is *The View of the Malayan Isles, New Holland, and the Spicy Islands.* All of the volumes contain a certain amount of botanical matter, chiefly appertaining to economic species, usually with their proper Latin binomials. Only three plant species are illustrated, *Tectona grandis* Linn.f., *Nepenthes distillatoria* Linn., and *Uvaria altissima* Koenig = *Polyalthia longifolia* (Sonn.) Benth. & Hook.f. These three drawings were prepared by Mr. Sowerby, which undoubtedly explains Pennant's use of the binomial *Uvaria altissima* Koenig.

Volume four is the one of chief interest to botanists, containing as it does Pennant's compiled *Flora Indica.* This is a list with references, not a descriptive flora. I judge that this work represents Pennant's chief excursion into the botanical field. His 1300 species are listed strictly in accord with the binomial system. At first it was thought that it was based largely on Burman's *Flora Indica* (1768), but there are few references to that work. Pennant eliminated most of Burman's Malaysian species, confining his list largely to continental ones, adding many others from the works of later authors. Both works contain approximately the same number of species, about 1300. Apparently the chief basis of the work was the Indian species listed in Reichard's *Systema plantarum* 1 (1779)— 4 (1780), for the page references following very many of the accepted names are to that work. In addition, however, he included various species from such works as Osbeck's *Dagbok* (1757), Sonnerat's *Voyage* (1782), Linnaeus f. *Supplementum plantarum* (1781), Roxburgh's *Plants of the Coast of Coromandel* 1 (1795) and 2 (1798), Loureiro's *Flora Cochinchinensis* (1790), Gaertner's *De fructibus et seminibus plantarum* 1 (1788) and 2 (1791), Woodville's *Medical Botany* (1790–93), and from certain works of L'Héritier, J. E. Smith, and perhaps other contemporary authors. He usually included references to the literature, citing many pre-Linnaean and post-Linnaean names; and where he occasionally published a new binomial, he associated the proper references with it.

At least one new binomial is published in the first volume of Pennant's

*** Pennant, T.** Outlines of the Globe **1:** i-iv. [1–9]. 1–263. [1–9]. *pl. 1–9.* 1798; **2:** [1–8]. 1–374. [1–13]. *pl. 1–14. 1 map.* 1798; **3:** i-xi. [1–4]. 1–284 [1–13]. *1 map.* 1800; **4:** [1–4]. 1–317. [1–21]. 1800.

work, but our chief interest is in volume four. The text of this last volume is largely devoted to a description of various islands and settlements, with notes on the peoples, plants and animals characteristic of them, the general headings being the Malayan Isles, Manila Islands, New Holland, Spicy Islands, Molucca Islands, Papua Islands, Land of Papua or New Guinea, New Britain, New Ireland, and "New Guinea again." The last part of this volume, pages 237–317, with eight additional pages of index, comprises Pennant's *Flora Indica*.

It is not clear that Pennant actually planned to publish new binomials, yet he definitely did so in a few cases. His new names, as far as noted, are disposed of below. The asterisk indicates their non-inclusion in *Index Kewensis* and its *Supplements*. Under the current provisions of the International Code of Botanical Nomenclature, where Pennant's names have priority, they should be accepted, but for the most part their listings merely adds to synonymy. *Piper macropiper* Pennant, *Ficus teregam* Pennant, and *Ficus peru teregam* Pennant (1800) seem to have clear priority, over *Piper arborescens* Roxb. (1814), (*P. miniatum* Blume, 1826), *Ficus wassa* Roxb. (1832), and *Ficus conora* King (1888), respectively. Because Pennant proposed various two-word binomials such as *arbor sambac, parana rubra, lobus litoralis, peru teregam,* some may object to their acceptance, but clearly these were all proposed as binomials. Two of the new binomials are due to Pennant's having inadvertently entered the names under the wrong generic designation. Several are merely due to typographical errors, and are perhaps unworthy of being listed.

Acalypha amentacea Roxb. Fl. Ind. ed. 2, 3: 676. 1832; Merr. Interpret. Herb. Amb. 322. 1917.

Acalypha spiciflora Burm.f. Index Alt. Herb. Amb. [5]. 1769, non *A. spiciflora* Burm.f. Fl. Ind. 203. 1768.

*Achyranthes *spiciflora* Pennant, Outl. Globe 4: 257. 1800 (Fl. Ind. 257).

Pennant's reference is "Cauda felis agrestis, Rumph. Amb. iv. p. 84." This same reference, plus *pl. 37. fig. 2*, is erroneously cited by Burman f. Fl. Ind. 203. 1768, as representing *Acalypha spiciflora* Burm.f.; but the form actually described and illustrated by him is *Cleidion spiciflorum* (Burm.f.) Merr. Interpret. Herb. Amb. 322. 1917 (*C. javanicum* Blume). Here Pennant erred, for clearly his intention was to make the entry under *Acalypha*, but by error placed it under *Achyranthes*.

Acalypha hispida Burm.f. Fl. Ind. 303. *pl. 61. fig. 1.* 1768; Merr. Interpret. Herb. Amb. 323. 1917.

*Achyranthes *hispida* Pennant, Outl. Globe 4: 257. 1800 (Fl. Ind. 257).

Pennant's reference is to "Cauda felis Rumph. Amb. IV. p. 82. t. 35 [36]." Here he erred in placing what is an *Acalypha* under the wrong generic designation, *Achyranthes*.

Dioclea reflexa Hook.f. Niger Fl. 306. 1849; Merr. Interpret. Herb. Amb. 280. 1917.

?*Phaseolus *parana rubra* Pennant, Outl. Globe 4: 288. 1800 (Fl. Ind. 288).

Pennant's whole reference is "*Rumph. Amb.* v.9.C.5," i.e., *Parrana rubra* Rumph. Herb. Amb. 5: 9. *pl. 15.* 1747. The plate is not good, but I

suspect that Rumphius attempted to represent the species currently known as *Dioclea reflexa* Hook.f. See the discussion in Merrill, Interpret. Herb. Amb. 280. 1917.

Epidendrum *fervum Pennant, Outl. Globe 4: 296. 1800 (Fl. Ind. 296), *sphalm.* = *E. furvum* Linn. = *Vanda furva* (Linn.) Lindl.

Epidendrum *spatulatum Pennant, l.c., *sphalm.* = *E. spathulatum* Linn. = *Vanda spathulata* (Linn.) Spreng.

Ficus *teregam Pennant, Outl. Globe 4: 313. 1800 (Fl. Ind. 313).
Ficus wassa Roxb. Fl. Ind. ed. 2, 3: 539. 1832; Merr. Interpret. Herb. Amb. 193. 1917.

Pennant's reference is "Caprificus aspera, *Rumph. Amb.* iii. 150 C.9," i.e., Herb. Amb. 3: 150. *pl. 94.* 1732. Here, as with his other new binomial in *Ficus,* he did not take the specific name from Rumphius, but accepted one from Rheede's *Hortus Malabaricus* because of Burman's note at the end of the Rumphian description "Videtur haec esse Teregam *H. Malab. part 3, Tab. 60* . . ." The local names given by Rumphius are *gobi, sajor wassa, wassa, utta sasuum, haat adam,* and *krotje.* The species is still known in Amboina as *wassa.*

Ficus *peru teregam Pennant, Outl. Globe 4: 313. 1800 (Fl. Ind. 313).
Ficus conora King, Ann. Bot. Gard. Calcutta 1: 103. *pl. 131.* 1888; Merr. Interpret. Herb. Amb. 195. 1917.

Pennant's reference is "Caprificus viridis *Rumph. Amb.* iii. 152.C.10." This is Chapter 10, and to the entry should be added *pl. 95.* The local name given by Rumphius is *mussu,* but as in the preceding case Pennant took his specific name from Burman's note at the end of the Rumphian description, p. 153: "Ramum exhibit *Caprifici viridis,* quae sine dubio est Peru Teregam *H. Malabar.* Tom. 3, Tab. 61 . . ." Thus we have two specific names for strictly Malaysian species of *Ficus* taken from the vernacular names of two different species from Malabar. In view of the fact that Pennant eliminated most of the Malaysian species listed in Burman's *Flora Indica* one suspects that, in proposing the two new specific names in *Ficus,* he thought that he was providing names for the continental forms described by Rheede; however, his references are strictly to Rumphius' *Herbarium Amboinense,* and the two species must be interpreted by what Rumphius illustrated and described.

Jasminum sambac (Linn.) Ait. Hort. Kew. 1: 8. 1879.
Nyctanthes sambac Linn. Sp. Pl. 6. 1753.
*Nyctanthes *arbor sambac* Pennant, Outl. Globe 4: 239. 1800 (Fl. Ind. 239).

The record is clear from the references to certain standard pre-Linnaean and post-Linnaean works. Pennant gives the page reference to Reichard's Systema Plantarum 1: 15. 1779, where, however, the entry is correctly given as *Nyctanthes sambac* Linn. Presumably he altered the specific name to make it agree, in form, with *Nyctanthes arbor tristis* Linn., which he also listed; or he may have taken the specific name from some pre-Linnaean work.

Madhuca indica J. F. Gmel. Syst. Nat. 2: 799. 1791.
Bassia latifolia Roxb. Pl. Coromandel 1: 20. *pl. 19.* 1795; Hook.f. Fl. Brit. Ind. 3: 544. 1882.
**Mahwah* **hamiltonia* Pennant, Outl. Globe 4: 280. 1800 (Fl. Ind. 280).
**Máhwah* (or *Madhúca*) C. Hamilt. As. Research. 1: 300. *1 pl.* 1788.
Bassia villosa Wall. List. no. 4165. 1830, *nom. nud.*
Madhuca latifolia Macbr. Contr. Gray Herb. 53: 17. 1918.

One might not be willing to accept C. Hamilton's original description of *Mahwah* as a formal generic one, although he provided a rather full technical description, and his plate shows the arrangement of the flowers and their details. He further stated that the tree belonged in the Polyandria Monogynia of Linnaeus "but of a genus not described by him.*" The tree that he described occurred in Behar and neighboring countries, there known as the *Máhwah* or *Máwee,* its Sanscritic name being *Madhúca.* The name *Madhúca* also appears on the plate. This Hamilton paper is the sole basis of Gmelin's formal description of the genus *Madhuca* Gmelin, and of its type species, *M. indica* J. F. Gmelin, Syst. Nat. 2: 799. 1791. Roxburgh, Pl. Coromandel 1: 20. 1795, also cited Hamilton's paper in the description of *Bassia latifolia* Roxb. Pennant, perhaps inadvertently, published a binomial under *Mahwah,* although he provided no description, so one must refer back to C. Hamilton's description to understand what was intended by Pennant's name. Here we have a formally published binomial under a generic name never recognized by other botanists.

Doctor Lam, Bull. Jard. Bot. Buitenz. III. 7: 182, 265. 1925, 8: 463. 1927, accepted the binomial *Madhuca longifolia* (Koenig [Linn.]) Macbr. Contr. Gray Herb. 53: 17. 1918, reducing *Bassia latifolia* Roxb. and *Madhuca indica* Gmelin to synonymy. Koenig's specimen is in the Linnaean herbarium and from a photograph of it available to me, and the comparative discriptions of *Bassia latifolia* Roxb. and *B. longifolia* Linn. by Hooker f. Fl. Brit. Ind. 3: 544. 1882, I am convinced that two different species are involved. To the synonymy of *Madhuca longifolia* (Linn.) Macbr. may be added *Bassia illipe* Linn. ex Jackson, Ind. Linn. Herb. 45. 1912, and *Illippe malabarorum* Koenig ex Linn. Mant. 2: 563. 1771, *nom. in syn.* Koenig was the author of the generic name *Bassia* in Linn. Mant. 2: 555. 1771, but Linnaeus was the author of the binomial *Bassia longifolia,* op. cit. p. 563, for he cited Koenig's different specific name as a synonym.

Mucuna gigantea (Willd.) DC. Prodr. 2: 405. 1825; Merr. Interpret. Herb. Amb. 277. 1917.
Dolichos giganteus Willd. Sp. Pl. 3: 1041. 1800 [1802].
Zoopthalmum giganteum Prain, Jour. As. Soc. Bengal 66(2): 68. 1897.
Phaseolus **lobus litoralis* Pennant, Outl. Globe 4: 289. 1800 (Fl. Ind. 289).

Pennant clearly confused two different species here, his reference being "Phaseolus *Lobus litoralis,* Rumph. Amb. V, 10 C. 6" (Rumph. Herb. Amb. 5: 10. *pl. 6.* 1747), and "Cacara pilosa, Rumph. Amb. V. p. 392. c. 35." These represent two very different species, the *lobus litoralis* belonging with

* **Hamilton, C.** A Description of the Máhwah Tree. As. Research. 1: 300–308. *1 pl.* 1788.

Mucuna gigantea (Willd.) DC., and the *Cacara pilosa* appertaining to *Mucuna aterrima* (Piper & Tracy) Merr. Interpret. Herb. Amb. 279. 1917 (*Stizolobium aterrimum* Piper & Tracy). Because of the confusion of the two by Pennant, Willdenow's slightly later specific name is retained, although from the first entry by Pennant, *lobus litoralis,* it is clear that what he probably meant was *Mucuna gigantea* (Willd.) DC.

Piper *macropiper Pennant, Outl. Globe 4: 242. 1800 (Fl. Ind. 242).
Piper arborescens Roxb. Hort. Beng. 80. 1814; Fl. Ind. 1: 161. 1820, ed. 2, 1: 159. 1832; Merr. Interpret. Herb. Amb. 180. 1917.
Piper miniatum Blume, Verh. Bat. Genootsch. 11: 166. 1826.

Pennant's hitherto overlooked binomial is based wholly on Rumphius, Herb. Amb. 5: 46. *pl. 28. fig. 1.* 1747, this illustration being an excellent representation of a characteristic and widely distributed species. It extends from the Malay Peninsula and Sumatra to Java, the Philippines, Celebes, Moluccas, New Guinea and the Solomon Islands. *Brass 2133* in the herbarium of the Arnold Arboretum, from Bougainville Island, is identified by Trelease as representing a new species, as yet unpublished. Comparison with a large suite of specimens and with Miquel's very fine plate representing *Piper miniatum* Blume, Nov. Act. Acad. Nat. Cur. Suppl. 21: *pl. 28.* 1844, clearly indicates that Trelease's supposed new species is the one discussed here.

Polyalthia longifolia (Sonn.) Benth. & Hook.f. ex Hook.f. & Th. in Hook.f. Fl. Brit. Ind. 1: 62. 1872; King, Ann. Bot. Gard. Calcutta 4: 72. *pl. 99.* 1893.
Uvaria longifolia Sonn. Voy. Ind. Orient. 4: 399. *pl. 131.* 1782, Reise 2: 244. *pl. 131.* 1783; Lam. Encycl. 1: 597. 1795; Dunal, Monog. Anon. 109. 1817; Roxb. Fl. Ind. ed. 2, 2: 664. 1832.
*Uvaria *altissima* Koenig ex Pennant, Outl. Globe 1: 83. *pl. 5.* 1798, 4: 280. 1800 (Fl. Ind. 280).

Pennant's first entry is "The *Poon* tree, *Uvaria altissima* of *Koenig,*" but he provided no description. He referred to Sonnerat's species as "*M. Sonnerat,* ii. p. 233, tab. 131, gives a figure of it, under the name of *L'Arbre de Mâture.*" In his second listing the entry is *Uvaria "altissima. Uv. longifolia, L'Arbre de Nature [Mâture] Sonnerat,* ii. 233. tab. 131.-Poon tree. Mast tree. *Outlines of the Globe,* 1: p. 83. tab. 5." Sonnerat's species was validly published with a short Latin diagnosis; this diagnosis is not repeated in the German edition of 1783. Curiously most of the references in botanical literature are to the German translation of 1783, not to the original French edition of 1782. In Sonnerat's original work "*Uvaria lanceolata Linn. Syst. nat.* gen. 692, sp. 4" appears as a synonym. The reference is to Gmelin's Syst. Nat. ed. 13, 2: 868. 1791; Linnaeus never published such a binomial. Manifestly what Gmelin considered was *Uvaria lanceolata* Sw. Prodr. 87. 1788 = *Oxandra lanceolata* (Sw.) Baill., of the West Indies, as Gmelin, like Swartz, cites a reference to P. Browne. In many standard works the binomial *Uvaria longifolia* is erroneously credited to Lamarck, usually, however, without a reference to the place of publication. A glance at Lamarck's Encycl. 1: 597. 1785, shows that he merely accepted Sonnerat's species, amplified the description,

commenting on Sonnerat's poorly engraved plate. This erroneous citation of Lamarck as the authority for the binomial commenced with Dunal in 1817.

Syzygium malaccense (Linn.) Merr. & Perry, Jour. Arnold Arb. 19: 215. 1938.
Eugenia malaccensis Linn. Sp. Pl. 470. 1753.
Jambosa malaccensis DC. Prodr. 3: 286. 1828.
Eugenia **nigra* Pennant, Outl. Globe 4: 277. 1800 (Fl. Ind. 277), non DC., 1828.

The basis of Pennant's binomial was "*Rumph.* i. 125. tab. 38. fig. 1," i.e., *Jambosa nigra* Rumph. Herb. Amb. 1: 125. *pl. 38. fig. 1.* 1741. It is a form of *Syzygium malaccense* (Linn.) Merr. & Perry, with unusually dark colored fruit (*Eugenia malaccensis* Linn. var. *nigra* Blume, Mus. Bot. Lugd.-Bat. 1: 91. 1849). The name *Eugenia nigra* DC. Prodr. 3: 286. 1828, based on Brazilian material, is invalidated by Pennant's earlier one.

***Trigonsanthes** Reichard, Syst. Pl. 4: 199. 1780; Pennant, Outl. Globe 4: 304. 1800 (Fl. Ind. 304), *sphalm.* = Trichosanthes Linn.

**amara* Reichard, Syst. Pl. 4: 200. 1780, *sphalm.* = Trichosanthes amara Linn.

**anguina* Reichard, op. cit. 199, *sphalm.* = Trichosanthes anguina Linn.

**cucumerina* Reichard, l.c., *sphalm.*; Pennant, Outl. Globe 4: 304. 1800 (Fl. Ind. 304), *sphalm.* = Trichosanthes cucumerina Linn.

**neruifolia* Reichard, l.c., *sphalm.* = Trichosanthes nervifolia Linn.

**nervifolia* Pennant, Outl. Globe 4: 304. 1800 (Fl. Ind. 304), *sphalm.* = Trichosanthes nervifolia Linn.

Curiously Reichard records the generic name correctly as *Trichosanthes* Linn., but under this generic entry he lists the four species as *Trigosanthes amara, anguina, cucumerina,* and *neruifolia.* In his unpaged *Index generum* the entry is *Trichosanthes,* while in his *Index synonymorum* it appears as *Trigosanthes.* The Pennant entry of 1800 is *Trigosanthes.*

EXPLANATION OF PLATE

UPPER FIG. The opening part of the Pennant manuscript.
LOWER FIG. A part of the first page of the printed document.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

Monandria Monogynia.

Canna Indica Syst. pl. 1. 2. Fl. zeyl. 1. Canna cornus Rumph. amb. v. p. 177. t. 71. f. 2. Katu Bala. Rheed. mal. 11. p. 85. t. 43. Flowring Reed Gerard 39. Outlines XI. 207.

Inhabits all parts of India. is found in Africa and S. america, is called India Shot from the form of the seeds. The Catholics and the Mahometan negroes make rosaries of them.

Renealmia exaltata. Lin Suppl. 79. Globba nutans Syst. pl. 1. 73. Globba sylvestris, mayor et minor. Rumph. amb VI. 149. tab. 62. 63.

Grows in the wet fields of Celebes, and rarely be-

FLORA INDICA.

MONANDRIA MONOGYNIA.

CANNA *Indica, Syſt. Pl.* i. p. 2. *Fl. Coch.* i. 13. *Fl. Zeyl.* 1. Cannacorus, *Rumph. Amb.* v. p. 177. t. 71. f. 2. Katu Bala, *Rheed. Mal.* ii. p. 85. l. 43. Flowering Reed, *Gerard*, 39. *Outlines of the Globe*, i. p. 316.—Inhabits all parts of *India*, is found alſo in *Africa* and *South America*. Called *Indian Shot*, from the form of the ſeeds, of which the *Catholics*, and the *Mahometan* negroes, make roſaries.

RENEALMIA *exaltata, Linn. Suppl.* 79. Globba Sylveſtris, major et minor, *Rumph. Amb.* vi. 140. tab. 62, 63. Grows in the wet fields of *Celebes*, and, rarely, behind *Victoria* caſtle, in *Amboina*. The fruit is of little uſe, but for its perfumed ſcent; is greedily eaten by the green parrots. The form of that of the *Sylveſtris* of ſingular growth. All the ſpecies given by *Rumphius* have the *Ternatic* name of *Globba*.

NOTEWORTHY SPECIES FROM MEXICO AND ADJACENT UNITED STATES, II

IVAN M. JOHNSTON

Amaranthus arenicola sp. nov.

Herba erecta dioica annua; caulibus pallidis 2–10 dm. altis simplicibus vel sparse ramosis; ramis strictis vel ascendentibus; lamina folii glabra lanceolata vel oblonga vel ovata 2–5 cm. longa 5–20 mm. lata infra medium latiore, apice acuta vel obtusiuscula, basi in petiolum pallidum gracilem 5–40 mm. longum abrupte contracta; inflorescentia terminali cymas abundantissimas composita spicata elongata 5–16 mm. crassa 1–4 dm. longa praesertim infra medium plus minusve interrupta ebracteata vel bracteis foliaceis sparsissime ornata; cymis latis ramosis conspicue bracteosis; bracteis ramorum cymis ovatis late sessilibus apice acutis cuspidatis, costa viridi paullo incrassata apice in acumen protracta, bracteis alibi membranacea; bracteis floris feminei obovatis, apice rotundis vel emarginatis rare cuspidatis fere ad altitudinem loborum perianthii attingentibus; lobis perianthii feminei pentameris 2.5–3 mm. longis infra medium in unguem ad 0.3 mm. latum abrupte contractis, lamina ad 1–1.8 mm. lata apice rotundata vel emarginata rariter cuspidata; utriculis paullo compressis 2–2.5 mm. longis circumscissilibus griseis saepe plus minusve verrucosis; stylis 3 gracilibus; seminibus laevis nigro-brunnescentibus nitidis biconvexis 1.3 mm. diametro; bracteis floris masculi lanceo-ellipticalibus acutis cuspidatis perianthium haud superantibus; lobis perianthii masculi pentameris late lanceolatis medium versus vel infra medium latioribus 1.3 mm. latis 2.5–3 mm. longis acutis cuspidatis; filamentis 5 filiformis ca. 1 mm. longis; antheris 5 ad 2 mm. longis.

KANSAS: sandhills, Hamilton County, 1895, *Hitchcock 428A* (TYPE, Gray Herb.); sandy soil, southwestern Kansas, Aug. 3, 1895, *Hitchcock 609*.

COLORADO: South Fork of the Platte, 1856, *H. Engelmann;* indefinite, 1861, *Parry 323*; Ft. Lupton, Weld. Co., 1914, *Johnston 275*; Gilcrest, Weld Co., 1916, *Johnston 275A*.

OKLAHOMA: bottom of Cimarron River, Cimarron Co., 1936, *Demaree 13306*.

TEXAS: Limpia Canyon, 8.7 miles northeast of Ft. Davis, 1942, *Cory 40520*.

INDEFINITE: Powell Colorado Exploring Exped., 1868, no. *509*; Upper Missouri River, *Hayden*; sandhills, 1862, *E. Hall*.

A species most closely related to *A. myrianthus* Standley of northeastern Mexico and southern Texas. The latter is a loosely and much branched plant with usually sprawling branches and has the bracts subtending the female flowers broad, cuspidate, and distinctly shorter than the perianth lobes. The plant here described grows in sandy places on the high plains. It has passed as *A. Torreyi* Gray and is treated under that name in Standley's revision of the genus, No. Am. Fl. **21**: 107 (1917). The name "*A. Torreyi* Gray," however, properly belongs to a very different plant growing along the Mexican boundary. Cf. Johnston, Jour. Arnold Arb. **25**: 155 (1944).

Portulaca parvula Gray, Proc. Am. Acad. 22: 274 (1887).

Plant prostrate or ascending, with a slender annual root; stems slender, 1–2 mm. thick, 3–15 cm. long, loosely branched; leaves 3–13 mm. long, 0.5–2 mm. broad, succulent, somewhat compressed; leaf axils with white hairs 3–7 mm. long; inflorescence terminal, a capitate cluster of 2–10 flowers, after falling of involucre bracts 3–6 mm. in diameter; involucre bracts 3–8 mm. long; sepals becoming reddish, 2.5 mm. long; petals yellow, orange, or bronze, 2–2.5 mm. long; capsule 1.5–2 mm. thick, basal portion saucer-shaped, with stipe 1–1.5 mm. long; seeds 3–3.5 mm. long, brownish at first but becoming black when mature, covered with minute crowded flattened stellate roughenings.

COAHUILA: Tanque Colorado, southeast of Zacatosa, common in shelter of bushes on red dunes, plant prostrate, light green, leaves terete and succulent, small flower orange, *Johnston 8658*.

CHIHUAHUA: Piramide, local on gravelly places at base of rock masses, *Johnston 8155*; Los Medanos, 1935, *LeSueur 254*; Sierra Santa Eulalia, fl. yellow, Aug. 18, 1885, *Pringle 543* (TYPE).

AGUACALIENTES: Aguacalientes, 1930, *Rose & Painter 7737*.

TEXAS: without locality, *Wright 31* in part and *873* in part.

ARIZONA: El Sauz, Cochise Co., *Hayes 72*.

OKLAHOMA: Kenton, bed of Cimarron River, 1936, *Demaree 13299*.

This species ranges in sandy places from western Texas and western Oklahoma to southeastern Arizona and south in northern Mexico to Aguacalientes. Its closest relative is *P. halimoides*, which occurs in the West Indies, in northern South America, and along the Pacific coast from Costa Rica north into Sonora and Baja California. The two species *P. parvula* and *P. halimoides* are set off from other congeners in Mexico and the United States by their small yellow, orange, or bronzy petals and their small, conspicuously stiped fruit. Their petals measure 2–3 mm. long. After dehiscence and shedding of seeds, the persisting saucer-shaped base of the capsule is only 1.5–2 mm. in diameter. Its stipe, however, is well developed and 1–1.5 mm. long.

As originally proposed by Gray, *P. parvula* was a mixture of two very distinct species, *P. parvula* as here redefined and *P. mundula* Jtn. However, judging from the specimens he identified and from details in his description, as well as from his choice of specific epithet, it seems clear that Gray was chiefly interested in the slender annual plant with small yellow flowers and stiped capsules to which I have restricted his binomial. Among his original suite of specimens only *Pringle 543* and portions of *Wright 31* and *873* belong to *P. parvula* as here delimited. The Pringle specimen, from the Sierra Santa Eulalia, Chihuahua, is taken as type. The Wright collections are mixtures, no. *31* consisting of *P. parvula* and *P. suffrutescens* and no. *873* of *P. parvula* and *P. mundula*. They appear to have been collected in the area between the Davis Mts. and the Coppermines, most likely somewhere along the old military road between the Davis Mts. and El Paso, in trans-Pecos Texas. Among Gray's material to be excluded from *P. parvula* are also *Fendler 73* and *Schaffner 772*. The Fendler collection, recently accepted as the type of *P. parvula* by Wilson, No. Am. Fl. **21**: 334 (1932), though labeled as from New Mexico, according to the

collector's field notes, actually originated in Kansas. It represents *P. mundula*. The Schaffner plant, from San Luis Potosi, has small flowers and small capsules, but the stipe of the fruit is short and the root is not slender and annual but fleshy and evidently perennial. It may possibly represent an undescribed species, but in any case cannot be accommodated in *P. parvula*.

Subsequent to Gray's publication of *P. parvula*, the species was accepted by Coulter, Contr. U. S. Nat. Herb. 2: 32 (1891), and by Robinson, Synop. Fl. 1: 264 (1897). These authors, however, repeated Gray's description and give no evidence of having examined the species critically. Wooton & Standley, Contr. U. S. Nat. Herb. 19: 230 (1915), however, delimited *P. parvula* in the sense I have accepted and also provided a key by which it can be separated from other species of *Portulaca* found in southwestern United States and northern Mexico. Wilson, No. Am. Fl. 21: 334 (1932), and Poellnitz, Fedde Repert. 37: 280 (1934), applied the name to the purple-flowered species I call *P. mundula*. Surprisingly, they have no concept for the yellow-flowered annual, the relative of *P. halimoides*, which should be called *P. parvula*. Kearney & Peebles, Fl. Pl. Arizona 302 (1942), apparently followed Wilson. The Arizonan plant they call "*P. parvula*" has purple petals 3–4 mm. long. It is conspecific with the New Mexican plant that Wooton & Standley called *P. pilosa*. Its correct name, however, is *P. mundula*.

Portulaca mundula, sp. nov.

Planta herbacea foliosa e radice palari non rariter incrassata ut videtur saepissime annua erumpens; caulibus 3–6, prostratis vel laxe decumbentibus vel laxe ascendentibus, 5–15 cm. longis, supra medium ascendenter ramosis, succulentis, internodiis valde abbreviatis 1–5 mm. longis; foliis carnosis, alternis, saepe numerosissimis et congestis, 5–15 mm. longis 0.5–1.5 mm. latis, linearibus vel oblanceo-linearibus ascendentibus; pilis axillae conspicuis languinosis crispis saepe candidis quam foliis brevioribus vel longioribus saepe 5–7 mm. longis; floribus terminalibus 2–8 in capitulos villosos aggregatis subsessilibus; foliis involucri 6–10 linearibus 5–12 mm. longis succulentis; calyce supra rupturam saepe ca. 4 mm. rariter ad 6 mm. longo; lobis triangularibus vel triangularo-oblanceolatis; petalis purpureis obovatis saepe ad 6 mm. vel rariter ad 7.5 mm. longis 3–4.5 mm. latis, apice retusis; staminibus saepe 10–15 rariter ad 30; stylis 3–5 oblanceolatis ca. 1.8 mm. longis; capsula maturitate in ¼ altitudine circumscisse ovato-globosa, parte superiori nitida alte hemispherica cum calyce corolla staminibus cohaerentibus emaradis vestita, parte inferiori 2.5–3.5 (saepe ad 3) mm. diametro brevissime stipitata; seminibus nigris 0.3–0.5 mm. diametro stellato-tuberculatis.

COAHUILA: Rancho Agua Dulce, *Wynd & Mueller 403*; Santa Anna Canyon, 1936, *Marsh 457*; Sierra Santa Rosa, July 27, 1938, *Marsh 1543*; Sierra Madera, Canon Charreteras, wet ground near tineja, fl. purple, *Johnston 8945A*; near Sacramento, gravelly wash, fl. purple, *Johnston 7088* (TYPE, Gray Herb.); Chojo Grande, 27 miles south of Saltillo, 1904, *Palmer 383*; Sierra Hechiceros, Canon Indio Felipe, crevices at base of cliff, *Stewart 291*; near Santa Elena, Sierra Cruces, along arroyo, fl. purple, *Stewart 601*; Valle Delicias, near Rancho La Boteca, frequent on limestone slope, fl. purplish, *Stewart 2933*.

CHIHUAHUA: Sierra San Carlos, gravelly slope below cliffs, fl. purple, *Johnston & Muller 45*; Piramide, gravelly soil at base of rock masses, *Johnston 8155A*; 7.5 miles south of Piramide, silty flat, prostrate, *Johnston 8103*; Sierra Santa Eulalia, fl. carmine, 6–8 in. broad, Aug. 18, 1885, *Pringle 334*.

TEXAS: Alpine, *Warnock 121*; 25 miles so. of Marathon, 1936, *Hinckley*; 18 miles so. of Marathon, 1933, *Cory 6901*; 20 miles SSE. of Kent, 1943, *Waterfall 5415*; 7 miles north of Van Horne, *Waterfall 4661*; Guadalupe Mts., Pine Springs Canyon, *Waterfall 5242*; Melon, Frio Co., 1941, *Tharp*; Mill Creek, 1843, *Lindheimer*; near Bracken, Bexar Co., *Groth 247* & *233*; Laredo, 1879, *Palmer 2141*.

OKLAHOMA: Lincoln County, 1895, *Blankinship*; Sapulpa, 1894, *Bush 31*; Alva, 1913, *Stevens 2884*; Pawhuska, 1913, *Stevens 2027*.

KANSAS: Allen County, 1896, *Hitchcock 630*; sandhills south of the crossing of the Arkansas River, fl. red, size of a half-dime, Sept. 3, 1847, *Fendler 73*.

MISSOURI: Cockrell, *Bush 6486*; Redings Mill, *Palmer 33157*; Garsney, 1898, *Bush 353*; Vale, 1908, *Bush 5238*.

In northern Mexico this species grows in gravel along sunny arroyos or on gravelly places on open slopes. From Coahuila and Chihuahua it ranges in its typical form north into trans-Pecos Texas. Specimens from northern Texas, Oklahoma, Kansas, and Missouri may differ slightly from more southern forms. Their flowers average a bit smaller while the stellate roughenings on their seeds are less commonly tuberculate.

The species has been confused with *P. parvula* Gray and *P. pilosa* L. Its relation with *P. parvula* have already been discussed. A consideration of *P. pilosa* shows it distinct from that species also. The name *P. pilosa* L., Sp. Pl. 445 (1753), is ultimately based on plants originating on the island of Curaçao, in the Dutch West Indies off the north coast of Venezuela. Linnaeus founded his species on descriptions and illustrations given in the published works of Royen, Commelin, Herman, and Plunkenet. These authors treated plants, cultivated in the gardens at Amsterdam and Leyden, said to have originated in Curaçao. The illustrations and comments by Commelin, Hort. Med. Amstelodam. 9, t. 5 (1697), and Herman, Par. Batavus 215 cum fig. (1705), are especially complete and clear and leave little doubt as to the identity of the plant properly called *P. pilosa* L. In Wilson's treatment of the genus, No. Am. Fl. 21: 334 (1932), it keys out to *P. pilosa* and *P. poliosperma*. Typical *P. pilosa* is a plant of Curaçao and so also is the variety, *P. pilosa* β, published by Linnaeus. The latter, based upon illustrations by Herman and Plukenet, was subsequently renamed *P. setacea* Haw. (1803) and *P. pilosa* var. *setacea* DC. (1828). It appears to be the plant later described as *P. venezuelensis* Urban (1907). Both of the Linnaean plants are tropical species from Curaçao and not conspecific with the plants of northern Mexico or southwestern United States.

Lippia lycioides (Cham.) Steud. Nom. Bot., ed. 2, 2: 54 (1841).

Aloysia lycioides Cham. Linnaea 7: 237 (1832).

Lippia ligustrina of authors.

This well-marked species of *Lippia* ranges in the United States from Texas to southeastern Arizona and in Mexico south to the states of Hidalgo, Puebla, Durango, and Sonora, and then again reappears in Bolivia (Cochabamba), Paraguay, and Brazil (Paraná) and extends

southward to the states of Buenos Aires, La Pampa, and Mendoza in Argentina. It is one of the xerophytic species shared by geographically remote areas in North and South America.

For a generation this shrub has been called *Lippia ligustrina* (Lag.) Britton. That name is based upon *Verbena ligustrina* Lagasca, Gen. et. Sp. Nov. 18 (1816), which was described as follows: "242 Verbena ligustrina: foliis ovatis, oblongisque scabris margine revolutis integerrimis: spicis cylandraceis terminalibus. Hab. in *Portu desiderato* ♄ (V. S.)." It is to be noted that the type was collected (probably by Nees) at Puerto Deseado, Terr. Santa Cruz, in southern Patagonia, and hence at a locality far to the south of the known range of our species in Argentina, and furthermore in a region in which it could hardly be expected. The scabrid leaves and terminal spikes of Lagasca's plant are not those of our *Lippia*. All details in the description do apply to one of the shrubby Argentine Verbenas related to *V. aspera* Gill. & Hook., which does grow at the Patagonian port. The name actually belongs to that species of *Verbena* and not to the subtropical *Lippia* shared by North and South America.

The name *Lippia lycioides*, based upon *Aloysia lycioides* Chamisso, is founded upon collections made by Sellow in southern Brazil. In treating the species Schauer, DC. Prodr. 11: 574 (1847), unfortunately cited the name *Verbena ligustrina* Lag. as one of its synonyms. Without verifying this reference, first Britton, Trans. N. Y. Acad. 9: 181 (1890), and later Kuntze, Rev. Gen. 3^2: 252 (1898), doing purely library botany, seized upon the incorrect synonym and launched the name "*Lippia ligustrina*" as a new appellation for our species. It was based upon a misidentification, taxonomically does not belong to our *Lippia*, and should be abandoned.

Tecoma Tronodora (Loes.), comb. nov.

Stenolobium Tronodora Loes. in Fedde, Repert. 16: 210 (1919).

Stenolobium incisum Rose & Standley, Contr. U. S. Nat. Herb. 16: 174 (1913).

Tecoma incisa (Rose & Stand.) Johnston, Jour. Arnold Arb. 21: 264 (1940); not Sweet (1827).

Tecoma stans var. *angustatum* Rehder, Mitt. Deutsch. Dendr. Ges. 1915: 227 (1915).

The name *Tecoma incisa* (Rose & Standl.) Johnston, being invalid because of an earlier homonym, a new name, under *Tecoma*, is needed for this widely distributed shrub of northern Mexico and adjoining United States. The name to be taken up for the plant, *Tecoma Tronodora*, embodies the vernacular name which I have found to be in general use and applied exclusively to this particular species in Coahuila and Chihuahua.

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NEOLITSEA (BENTHAM) MERRILL, NOMEN CONSERVANDUM PROPOSITUM

E. D. MERRILL

PAX IN HIS TREATMENT of the Lauraceae, Engler & Prantl, Nat. Pflanzenfam. 3(2): 119. 1889, logically separated a distinctly natural Old World group from *Litsea* Lam., selecting as his designation for the segregated group the generic name *Tetradenia* Nees in Wallich, Pl. As. Rar. 2: 61. 1831. He unfortunately overlooked the fact that this name was preoccupied by *Tetradenia* Benth. (1830), the latter being universally accepted as the valid name for a genus of the Labiatae, and adopted by Briquet in his treatment of the Labiatae, Nat. Pflanzenfam. 4(3A): 331. 1897. Bentham in Bentham and Hooker f. Gen. Pl. 3: 161. 1880, characterized the same group of lauraceous plants as *Litsea* Lam. sect. *Neolitsea* Benth. briefly describing it as: "Folia saepius triplinervia. Flores saepius 2-meri, perianthii segmentis 4, staminibus perfectis 6." He cited *Tetradenia* Nees (1831), non Benth. (1830), as a synonym. *Neolitsea* Bentham was merely a new name for *Tetradenia* Nees, but unfortunately Bentham designated it as of sectional status only.

In 1906 I noted that the generic designation *Tetradenia* Nees was invalid for the group under consideration and accordingly, Philip. Jour. Sci. 1: Suppl. 56. 1906, rather casually raised *Neolitsea* Benth. to generic status, as *Neolitsea* (Benth.) Merr. citing *Tetradenia* Nees as a synonym, and publishing the first three binomials under it. At that time I was not aware of the fact that there was still an earlier generic name available, for I did not then have access to any of the rare Rafinesque publications.

In attempting to list and to reduce the numerous new names published by Rafinesque between the years 1808 and 1840, in his unbridled publishing career, I became involved in the determination of the identity of the proposed new genus *Bryantea* Raf. Silva Tellur. 165. 1838 which proved to be a very simple matter. The record is clear for although the generic description is very short, as is usually the case with Rafinesque, the type of the genus is clearly indicated. The following is all that Rafinesque published about his new genus:

"59. BRYANTEA Raf. (bot) diff. cal corol 4 part. stam. 6.—Type *Br. dealbata* Raf. Tetranth. do. R. Brown, Sm. & c." The type is therefore the Australian *Tetranthera dealbata* R. Brown. With the wide concept usually given to *Litsea* Lamarck, by Bentham and Hooker f., by Pax, as well as by recent authors, *Bryantea* was naturally placed as a synonym of Lamarck's genus, although it was not mentioned in the Genera Plantarum; it is a definite synonym of *Litsea* Lam. sect. *Neolitsea* Benth. = *Neolitsea* (Benth.) Merr.

Under the priority rule *Bryantea* Raf. (1838) antedates *Neolitsea* (Benth.) Merr. (1906) (*Litsea* Lam. sect. *Neolitsea* Benth., 1880) by sixty-eight years and unless the latter be conserved it will be necessary to accept Rafinesque's earlier name and if accepted it will involve the publication of about 100 new binomials under *Bryantea*. This is only one of about 70 cases where it is now clear that generic names proposed by Rafinesque are earlier than those in current use for the same groups, proposed by other authors at later dates, in spite of the fact that already nearly 80 of Rafinesque's validly published generic names have been officially included in the list of rejected ones. This total of 150 generic names gives us a scale by which to judge how little confidence Rafinesque's contemporaries and successors had in his work. He thus became a victim of the weight of authority; for the great botanical authorities of nineteenth century botany rather consistently ignored his nomenclatural proposals. My personal opinion is that where only a few binomials are involved, and in those cases where genera contain few or no species of economic or of horticultural importance, or unless they contain a large number of species, that the rule of priority should prevail and that Rafinesque's earlier names should be adopted. A case in point is the genus *Beauverdia* Herter, published in 1941 to take a single South American species of the Liliaceae which has within the past century found its place at various times under no less than seven different generic names. Two years after Herter proposed his new generic name, Mr. Stearn called attention to the fact that in 1837 Rafinesque based his new genus *Ipheion* on the same species (*Milla uniflora* Grah., *Triteleia uniflora* Lindl., *Brodiaea uniflora* Engl., *Leucoryne uniflora* Greene, *Hookera uniflora* O. Kuntze); and now to this impressive list of names for one species must be added *Beauverdia uniflora* Herter (1841), and *Ipheion uniflorum* Raf. (1838), the last name in this list being the proper one; see Stearn, Gard. Chron. III. 114: 60. 1943. I agree with Mr. Stearn that there is no justification whatever in accepting *Beauverdia* Herter (1941) and rejecting *Ipheion* Raf. (1838), for Rafinesque's name has priority by more than a century, and only a single species is involved.

In my investigations of Rafinesque's numerous new names, a surprisingly large number of which do not appear in any standard index, I have not accepted a single Rafinesque generic name, even when it can definitely be proved that this or that one has priority over currently used ones. In preparing my Index Rafinesquianus it was decided not to utilize its pages as a medium for the publication of new names. I prefer in general to let the specialist make the recommendations as to which generic names should be accepted and which should eventually find their places in the list of officially rejected ones. It seems to me, however, that this *Neolitsea-Bryantea* case is clearly one where the former name should be conserved; not because I was originally involved in the acceptance of *Neolitsea* as of generic status, but rather because of the currently wide acceptance of the name, the very wide geographic distribution of the species (India and

Ceylon to China and Japan, southward through Malaysia to eastern Australia), and the distinctly large number of species involved. Since *Neolitsea* (Benth.) Merr. was accepted as of generic status in 1906 about 80 binomials have been published under it; below eleven additional transfers are made. With various *Litsea* and *Tetradenia* names still to be transferred approximately 100 binomials are involved in *Neolitsea* most of which would have to be republished under *Bryantea* Raf. unless the latter name be rejected. I have the general feeling that where fifty or more binomials are involved, perhaps as few as half that number, that when an older generic name is discovered which would replace a currently used one on the basis of priority, no matter who its author may be, that it should be officially rejected in favor of the currently used one. Incidentally sixteen botanists have already accepted *Neolitsea*, including Airy-Shaw, Allen, Alston, Cowan, Elmer, Gamble, Kanehira, Koidzumi, Lecomte, Liou, Nakai, and S. Moore.

Neolitsea dealbata (R. Br.) comb. nov.
Tetranthera dealbata R. Br. Prodr. 403. 1810.
Litsea dealbata Nees Syst. 630. 1836.
Bryantea dealbata Raf. Silva Tellur. 165. 1838.

This well marked Australian species is apparently common in Queensland and occurs also in New South Wales, the type from near Port Jackson. There are about 20 individual collections representing the species in the herbarium of the Arnold Arboretum, the oldest one being a specimen collected by Fraser at Moreton Bay in 1828. It is very doubtful if *Tetranthera rufa* Nees Syst. Laur. 631. 1836, is specifically distinct. Bentham, Fl. Austral. 5: 308 1870, surely intended to place it as *Litsea dealbata* Nees var. *rufa* Benth., but he did not cite the Nees binomial. The type was from near Brisbane. Incidentally Bentham's interpretation of *Litsea* in the Flora Australiensis is strictly confined to what we call *Neolitsea;* what we now place in *Litsea* Lam. he placed in *Tetranthera* Jacq.

Dr. H. Teschner in his treatment of the Lauraceae of New Guinea, Bot. Jahrb. 58: 381–440. 1923 (pp. 388–393) accepted the generic name *Tetradenia* Nees (1831) for this group, apparently not noting that it was invalidated by the earlier *Tetradenia* Benth. (1830), of the Labiatae. He provided a key to the ten species that he described as new, these being disposed of as follows:

Neolitsea acuminata (Teschn.) comb. nov.
Tetradenia acuminata Teschn. Bot. Jahrb. 58: 392. 1923.
Northeast New Guinea, Kaiserin Augusta River.

Neolitsea acuta (Teschn.) comb. nov.
Tetradenia acuta Teschn. op. cit. 391.
Same region as the preceding species.

Neolitsea Clarissae (Teschn.) comb. nov.
Tetradenia Clarissae Teschn. op. cit. 390.
This, with its variety *pulchra* Teschn. l.c., from the same region as the above two species.

Neolitsea glabra (Teschn.) comb. nov.
Tetradenia glabra Teschn. op. cit. 392.
Also from the Kaiserin Augusta River.

Neolitsea longifolia (Teschn.) comb. nov.
Tetradenia longifolia Teschn. op. cit. 389.
Also from the Kaiserin Augusta River.

Neolitsea minor (Teschn.) comb. nov.
Tetradenia minor Teschn. op. cit. 390.
Bismarck Mountains.

Neolitsea Melchioriana (Teschn.) comb. nov.
Tetradenia Melchioriana Teschn. op. cit. 389.
Kaiserin Augusta River.

Neolitsea novo-guinensis (Teschn.) comb. nov.
Tetradenia novo-guinensis Teschn. op. cit. 393.
Kaiserin Augusta River.

Neolitsea papuana nom. nov.
Tetradenia latifolia Teschn. op. cit. 391, non *Neolitsea latifolia* (Blume) S. Moore (1925).
Kaiserin Augusta River.

Neolitsea pubescens (Teschn.) comb. nov.
Tetradenia pubescens Teschn. op. cit. 391.
Kaiserin-Augusta River.

In addition to the above there is one invalid published but unlisted name in *Neolitsea*, this being *N.* **latifolia* Koidz. in Doi, Fl. Satsum. 2: 102. 1931, non S. Moore (1925), a Japanese species, but its description is not available to me, hence no new name is proposed for it. It is not included in the Index Kewensis supplements. In this category of unlisted binomials is *N.* **gilva* (Makino & Nemoto) Koidz. Bot. Mag. Tokyo 32: 257. 1918, and *N.* **aurata* (Hayata) Koidz. l.c., the latter replacing *N. aurata* (Hayata) Merr. (1927).

Perhaps pertinent to this discussion is this brief note on the generic name *Litsea* Lamarck. Currently its date of publication is indicated as 1789; it was not published until 1791. It is officially conserved against *Malapoenna* Adanson (1763), *Glabraria* Linn. (1771), and *Tomex* Thunberg (1783). I call attention to the fact that *Glabraria* Linn. has nothing to do with *Litsea* Lam., for the original Linnaean description, which is excellent, was based on an actual specimen, and that *Glabraria* Linn. (1771) will replace the bombacaceous *Boschia* Korth. (1842) unless the latter be officially conserved. To the list of rejected names, as long as *Litsea* Lam. is accepted in its present broad sense, should be added *Hexanthus* Lour. (1790), *Sebifera* Lour. (1790), *Quinquedula* Noronha (1790), and perhaps *Fiwa* J. F. Gmel. (1791).

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NOMENCLATURAL NOTES ON RAFINESQUE'S PUBLISHED PAPERS 1804–1840

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AN INTENSIVE EXAMINATION of all the known botanical publications of C. S. Rafinesque, issued between the years 1804 and 1840, bring out some very striking facts. In the long history of systematic botany no individual has suffered under the weight of authority to the extent of that illguided and erratic individual. His contemporaries considered his very numerous nomenclatural proposals to be illogical and uncalled for, and they accordingly very largely ignored his published work. There was no general priority rule in force at the time and doubtless his contemporaries, judging his work to be valueless, felt justified in ignoring it. He published an extraordinary number of new genera, new subgenera, new species, and new varieties, yet of his approximately 2700 legitimately published new generic names only about 30 are more or less universally accepted by botanists, and the percentage of currently accepted Rafinesque binomials is scarcely better.

If one examines the list of rejected generic names officially approved by the various International Botanical Congresses, it will be found that Adanson ranks first, with about 115 in this category, while Rafinesque is now second, with 77 rejected names; and actually the latter bids fair to replace Adanson in the first place in this unflattering category. The reason for rejecting casually published, long overlooked or little used generic names in favor of later ones proposed by other authors is, of course, to avoid the publication of numerous new binomials which would be required if the generally equitable rule of priority be strictly followed. Rafinesque insisted that time would render justice to him at last, but he was over-optimistic. It is unnecessary at this time to go into further details regarding the strange publishing activities of that erratic individual, for in the now completed *Index Rafinesquianus,* which it is hoped may be published within a year or so, ample data are included about him, his objectives, his ambitions, his career, and its unhappy end.

It is suspected that various botanists who knew that I was making a bibliographic study of Rafinesque's publications assumed that I would hew to the line and make an extraordinary number of new combinations on the basis of priority except as various Rafinesque generic names have been officially rejected. Nothing was further from my thought. A considerable amount of random sampling indicated that a great many of Rafinesque's legitimately published new genera and new species had been entirely overlooked by his contemporaries and successors. The extent of this oversight is indicated by the statement that there are actually not included in any

of our standard indices no less than about 740 of Rafinesque's legitimately published generic names, 325 subgeneric and sectional names, 2560 binomials, and 900 varieties; and all of these were published more than a century ago. After all, we do have a homonym rule, and this alone is sufficient reason for at least listing Rafinesque's proposed new names for plants.

In the projected *Index Rafinesquianus* it is not proposed to publish any new names. In my personal opinion, indices, dictionaries, encyclopedias, and popular descriptive floras are not proper places in which to publish new nomenclatural proposals; this for the simple reason that all such works become obsolete within a relatively short period of time, and further, because it is often very difficult to detect new names published in such works. I have preferred to list the new technical names as Rafinesque published them, making such reductions as seem definitely to be correct. I leave the matter of further identification, or even the rejection of this or that entity, to specialists, monographers, and those who, from intensive field work, have a wide working knowledge of the flora of this or that region. To attempt to reduce all of Rafinesque's very numerous species is a task quite beyond the ability of any one individual, for his work touched every major floristic area of the entire world. In actual practice it is usually possible definitely to determine the positions of his numerous new genera with certainty.

In spite of Rafinesque's vast publishing activities; in spite of the inordinate number of new genera and new species which he proposed and which, unfortunately, he usually characterized in a most sketchy manner; and in spite of the relatively early time that he was active in the publishing field (the first four decades of the last century), the nomenclatural upsets resulting from an intensive study of his proposals are relatively few. In fact, if we take advantage of the facilities by which certain of his generic names may ultimately be disposed of by making certain additions to the list of *nomina generica conservanda,* the necessary changes will be very few indeed. In the course of my investigations, where I have encountered nomenclatural proposals appertaining to the area covered by Gray's Manual, I have called special cases to the attention of Dr. M. L. Fernald, who is now completing his very critical revision for the eighth edition of that standard work. He has, particularly in the past decade, considered a number of Rafinesque proposals as to species, publishing from time to time in *Rhodora.* Occasionally other recent authors have given consideration to Rafinesque genera and species. Within the present century those American botanists who believe in numerous small genera as opposed to fewer large, more or less collective ones, have reinstated approximately 75 of Rafinesque's generic names; very few taxonomists have accepted their conclusions.

Considering the time in which Rafinesque was active and the vast field that he attempted to cover, a remarkably small percentage of his proposals in any way affect nomenclature now that we have the protection of the

officially approved list of *nomina generica conservanda;* they do, however, add vastly to our already complicated synonymy. In this short paper I consider a very few cases, accepting an occasional Rafinesque specific name as valid on the basis of priority. The surprising thing is that there are so very few indicated changes.

Taking up Rafinesque's proposed generic names, I note above that no less than 77 of these have already been officially rejected. Below I give a list of Rafinesque generic names, arranged in natural groups, where in each case (or at least in most cases) he has clear priority over the proposed names of other authors which are in current use. In practically every listed case it is the privilege of any author to accept some or all of these earlier Rafinesque generic names and to transfer hundreds of specific names to them; as a matter of fact without resorting to the conservation of generic names, where many binomials are involved, approximately 2,000 new binomials are possible.

In my personal opinion some of these Rafinesque generic names should be officially rejected, but I would not go so far as to reject all of them. I believe that recommendations for the rejection of selected names should come from specialists. If the group be a small one, and one in which there are no, or but few species of economic or horticultural importance, then my belief is that the Rafinesque generic name should be accepted, and the currently used one dropped into synonymy. In the case of all large genera I believe that the older Rafinesque names should be rejected; and to this list of large genera should be added certain of those names where economic species are involved, even if the genus be a small one such as *Xylia* Benth. (1842), for *Esclerona* Raf. (1838) was based on the same type, *Xylia xylocarpa* (Roxb.) Taub. (*Esclerona montana* Raf., *Xylia dolabriformis* Benth.); this is an important timber tree in India. Because of the horticultural importance of other groups I should not replace *Montrichardia* Crueg. (1854) by the earlier *Pleuropsa* Raf. (1838), or in the Orchidaceae, such changes as would be required if *Bifrenaria* Lindl. (1843) be replaced by *Adipe* Raf. (1837) and *Lycaste* Lindl. (1843) by *Deppia* Raf. (1837); nor in the Bignoniaceae would I replace *Kigelia* DC. (1845) by the earlier *Kigelkeia* Raf. (1838) because of the wide use of certain species of this genus in the tropics as ornamental trees.

I do not believe that the generic names for large groups should be changed even if Rafinesque's legitimately published ones for the same groups are earlier. Examples are *Castanopsis* Spach (1842) versus *Balanoplis* Raf. (1838); *Pasania* Oerst. (1866) versus *Arcaula* Raf. and *Balanaulax* Raf. (1838); *Neolitsea* (Benth.) Merr. (1905) versus *Bryantea* Raf. (1838); *Astronidium* A. Gray (1854) versus *Lomanodia* Raf. (1838); *Planchonella* Pierre (1890) versus *Xantolis* Raf. (1838); *Anemopaegma* Mart. (1845) versus *Cupulissa* Raf. (1837) and *Platolaria* Raf. (1838); *Daedalacanthus* T. Anders. (1864) versus *Upudalia* Raf. (1838); *Struthanthus* Mart. (1830) versus *Steirotis* Raf. (1820); *Lesquerella* S. Wats. (1888) versus *Discovium* Raf. (1819); *Cyclobalanopsis* Oerst.

(1865) versus *Perytis* Raf. (1838), and various others of this general nature.

Where the groups are small and of interest only to taxonomists, my feeling is that the earlier Rafinesque names should be adopted and later ones dropped into synonymy. Thus I can see no valid reason for accepting *Beauverdia* Herter, which was proposed to take a single South American species in 1941 when more than a century earlier (1838) Rafinesque based his genus *Ipheion* on the same type.[1] Even were I disposed to follow the late Dr. J. K. Small in his concept of small genera I see no justification for accepting the new generic names proposed by him between 1903 and 1933, when it can be shown that Rafinesque antedated him by a century or so.

In the official list of conserved names several may now be eliminated, for conservation was unnecessary. These are *Gynizodon* Raf. (1838) rejected in favor of *Miltonia* Lindl. (1837) (Orchidaceae); *Hexastylis* Raf. (1837), non Raf. (1825) and *Stylexia* Raf. (1838), rejected in favor of *Caylusea* St. Hil. (1837) (Resedaceae) and *Arkezostis* Raf. (1838), rejected in favor of *Cayaponia* Silva Manso (1836) (Cucurbitaceae). *Amorgyne* Raf. (1838) and *Bunilis* Raf. (1838) were rejected in favor of *Siphonychia* Torr. & Gray (1838). The reasons why they were rejected is that it was assumed that the title page dates in the several Rafinesque volumes where these names were first published were correct; but actually certain volumes dated 1836 were not published until 1837 and 1838.

I have included several entries where the different generic names were published in the same year. It may be possible to determine from reviews, or from other sources, which author actually does have priority, but I have made no serious attempt to determine this point. The cases are *Sabadilla* Raf. (1837) = *Sabadilla* Brandt & Ratzeb. (1837) = *Schoenocaulon* A. Gray (1837) (Liliaceae); *Gomphotis* Raf. (1838) = *Thryptomene* Endl. (1838) (Myrtaceae); *Borissa* Raf. (1820) = *Asterolinon* Hoffm. & Link (1820) (Primulaceae); and *Bubalina* Raf. (1820) = *Burchellia* R. Br. (1820) (Rubiaceae).

It has been suggested by some individuals that with the discovery of so many new generic and specific names which have been overlooked for more than a century, that the logical thing to do would be to outlaw all of Rafinesque's nomenclatural proposals which have not already been accepted by this or that botanist. Admittedly this would be a simple way out of the difficulties which confront us, but my reaction to such a proposal is that those who suggest this plan are really not well versed in the intricacies of botanical bibliography and nomenclature. I can see no reason for such an unjustifiable action. Incidentally it would for all time penalize that school of taxonomists who believe in small versus large genera, such as Messrs. Britton, Rose, Small, Rydberg, Greene, and others; for when they were seeking for names for generic segregates, they drew heavily on Rafinesque's proposals, even as Rafinesque drew on Adanson. The con-

[1] **Stearn,** T. Ipheion uniflorum (syns. Triteleia, Milla, Brodiaea, and Beauverdia uniflora). Gard. Chron. III. **114:** 60–61. *fig. 31–32.* 1943.

servative botanist may object to the ideas, as to generic limits, of this school; in fact the evidence is that most botanists do not favor undue splitting of the larger more or less collective genera. They feel that interrelationships of groups can be indicated just as clearly by recognizing subgenera and sections. In the tabulated list of these old but generally overlooked Rafinesque generic names, there are approximately 75 cases where within the present century his names have been accepted in good faith by members of the school referred to, even if most systematists will, in all probability, look askance on such segregations.

It is true that in some cases these "splitters" did propose new generic names for some of the segregated groups when resource could have been had to Rafinesque's proposals. This is, however, not an unnatural oversight. The chief sinner in this respect was the late Dr. J. K. Small. I list here a number of illustrative cases. *Phyodina* Raf. 1837 (*Cuthbertia* Small, 1903, *Tradescantella* Small, 1903); *Galearis* Raf., 1833 (*Galeorchis* Rydb., 1901); *Pecteilis* Raf., 1837 (*Hemihabenaria* Finet, 1901); *Phyllepidum* Raf., 1808 (*Delopyrum* Small, 1913); *Plagidia* Raf., 1838 (*Gastronychia* Small, 1933); *Tarenaya* Raf., 1813 (*Neocleome* Small, 1933); *Zalitea* Raf., 1838 (*Zygophyllidium* Small, 1803); *Cartrema* Raf., 1838 (*Amarolea* Small, 1933); *Piloblephus* Raf., 1838 (*Pycnothamnus* Small, 1903); *Dasistoma* Raf., 1819 (*Brachygyne* Small, 1903); *Etornotus* Raf., 1840 (*Hydrotrida* Small, 1913); and *Ptilepeda* Raf., 1818 (*Tetraneuris* Greene, 1898).

Here are some illustrative cases of reinstatement of Rafinesque generic names within the present century: *Nemexia* Raf., taken out of *Smilax* Linn., *Blephariglottis* Raf. taken out of *Habenaria* Willd., *Tracaulon* Raf. taken out of *Polygonum* Linn., *Heterisia* Raf. and *Steiranisia* Raf. taken out of *Saxifraga* Linn., *Ozomelis* Raf. and *Pectiantia* Raf. taken out of *Mitella* Linn., *Dasyphora* Raf. taken out of *Potentilla* Linn., *Stylipus* Raf. taken out of *Geum* Linn., *Acmispon* Raf. taken out of *Hosackia* Dougl., *Adipera* Raf., *Ditremexia* Raf., *Emelista* Raf., *Herpetica* Raf., *Isandrina* Raf. and *Peiranisia* Raf. taken out of *Cassia* Linn., *Ascara* Raf. taken out of *Gleditsia* Linn., *Lomoplis* Raf. taken out of *Mimosa* Linn., *Neltuma* Raf. and *Orbexilum* Raf. taken out of *Psoralea* Linn., *Poponax* Raf. taken out of *Acacia* Willd., *Asemeia* Raf., *Pilostaxis* Raf. and *Trichlisperma* Raf. taken out of *Polygala* Linn., *Agaloma* Raf., *Lepadena* Raf. and *Zalitea* Raf. taken out of *Euphorbia* Linn., *Meriolix* Raf. taken out of *Oenothera* Linn., *Braxilia* Raf. and *Orthilia* Raf. taken out of *Pyrola* Linn., *Polycodium* Raf. taken out of *Vaccinium* Linn., *Steironema* Raf. taken out of *Lysimachia* Linn., *Stylisma* Raf. taken out of *Breweria* R. Br., *Thyella* Raf. taken out of *Ipomoea* Linn., *Decimum* Raf. taken out of *Hydrophyllum* Linn., *Stylodon* Raf. taken out of *Verbena* Linn., *Stomosia* Raf. and *Vesiculina* Raf. taken out of *Utricularia* Linn., *Distegia* Raf. and *Phenianthus* Raf. taken out of *Lonicera* Linn., *Triodanis* Raf. taken out of *Specularia* A. DC., *Mesadenia* Raf. taken out of *Senecio* Linn., and *Synosma* Raf. taken out of *Cacalia* Linn.

It is infinitely better in such cases, where an author really believes in narrow generic limits, to take names for his segregated groups from the earlier literature, when valid names are therein available, rather than to originate entirely new ones as Dr. Small did in a number of cases. Because of the low esteem in which Rafinesque's nomenclatural proposals have been held in the past, one suspects that the very fact that this or that modern author who accepts one of them will, in general, not be followed by the conservatives. Yet in spite of our prejudices against Rafinesque he was clearly correct in a great many of his generic proposals, even if modern botanists have officially rejected about 75 of them where he had clear priority; and undoubtedly many more will be added to this unflattering list. The botanists concerned in the generic segregates listed above were mainly E. L. Greene, N. L. Britton, J. N. Rose, P. A. Rydberg, J. K. Small, J. A. Nieuwland, H. D. House, and J. H. Barnhart.

VALID BUT AS YET NOT GENERALLY ACCEPTED RAFINESQUE GENERIC NAMES AND THEIR EQUIVALENTS.

ALGAE:

Arthrodia Raf. 1814 = Roya W. & G. West, 1896 = Closterium Nitzsch., 1817, *sensu lat.*
Dictilema Raf., 1814 = Microdictyon Decne., 1859.
Liacina Raf., 1825 = Tolypella R. Br., 1848.
Phoracis Raf., 1810 = Grateloupia Agardh, 1822.

FUNGI:

Acinophora Raf., 1806, 1814 = Arachnion Schwein., 1822.
Colonnaria Raf., 1806 = Linderia G. H. Cunningh., 1931, non Lindera Adans. (1763), nec Thunb. (1783).
Gemmularia Raf., 1819 = Tucahus Raf., 1830 = Pachyma DC. 1823.
Hydromycus Raf., 1808 = Hypolepis Raf., 1808 = Dacryomyces Nees, 1821.
Odontium Raf., 1838 = Odontia (Pers.) P. Henn., 1897.

ALISMATACEAE:

Luronium Raf., 1840 = Elisma Buchen., 1869 (1).[2]

GRAMINEAE:

Amphicarpon Raf., 1818 = Amphicarpum Kunth, 1829 (2).
Rytilix Raf., 1830 = Hackelochloa O. Kuntze, 1891 (1).

ARACEAE:

Pleuropsa Raf., 1838 = Montrichardia Crueg., 1854 (4).

COMMELINACEAE:

Dilasia Raf., 1838 = Streptylis Raf., 1838 = Phaeneilema Brückn., 1926 (*Murdannia* Royle, 1839; *Dichoesperma* Wight, 1853; *Prionostachys* Hassk., 1866; *Baulia* A. Chev., 1912) (30).
Heminema Raf., 1837 = Tripogandra Raf., 1837 (*Descantaria* Schlecht., 1853; *Disgrega* Hassk., 1866) (20).
Phyodina Raf., 1837 (*Cuthbertia* Small, 1903; *Tradescantella* Small, 1903) (5).
Siderasis Raf., 1837 = Pyrrhemia Hassk., 1869 (4).

LILIACEAE:

Aphoma Raf., 1837 = Iphigenia Kunth, 1843 (20).
Hexonix Raf., 1837 = Kozola Raf., 1837 = Heloniopsis A. Gray, 1859 (10).

[2] For the genera of flowering plants the figures in parentheses indicate the approximate number of species involved in each case. The total is in excess of 2000 binomials, varying from one or two in some genera to 200 or more in the extreme cases.

Ipheion Raf., 1837 = Beauverdia Herter, 1941 (1).
Sabadilla Raf., 1837 = Sabadilla Brandt & Ratzeb., 1837 = Schoenocaulon A. Gray, 1837 (*Skoinolon* Raf., 1838) (12).
Siraitos Raf., 1838 = Chionographis Maxim., 1867 (5).

IRIDACEAE:
Phaiophleps Raf., 1838 = Symphyostemon Miers, 1841 (10).

ORCHIDACEAE:
Adipe Raf., 1837 = Bifrenaria Lindl., 1843 (30).
Caularthron Raf., 1837 = Diacrium Benth., 1881 (8).
Deppia Raf., 1837 = Lycaste Lindl., 1843 (50).
Dilomilis Raf., 1838 = Octadesmia Benth., 1881 (6).
Galearia Raf., 1833 = Galeorchis Rydb., 1901 (4) = Cypripedium Linn., *sensu lat.*
Jimensia Raf., 1838 = Bletilla Reichb. f., 1851–53 (12).
Pecteilis Raf., 1837 = Hemihabenaria Finet, 1901 (3) = Habenaria Willd., 1805, *sensu lat.*
Tulotis Raf., 1833 = Perularia Lindl., 1835 (10) = Habenaria Willd., 1805, *sensu lat.*

FAGACEAE:
Arcaula Raf., 1838 = Balanaulax Raf., 1838 = Pasania Oerst., 1866 (200).
Balanoplis Raf., 1838 = Castanopsis (D. Don) Spach, 1842 (150).
Perytis Raf., 1838 = Cyclobalanopsis Oerst., 1866 (65).

LORANTHACEAE:
Glutago Comm. ex Poir., 1821 = Oryctanthus Eichl., 1868 (20).
Hemitria Raf., 1820 = Phthirusa Mart., 1830 (80).
Steirotis Raf., 1820 = Struthanthus Mart., 1830 (140).

SANTALACEAE:
Nestronia Raf., 1838 = Darbya A. Gray, 1846 (1).

POLYGONACEAE:
Phyllepidum Raf., 1808 = Delopyrum Small, 1913 (5) = Polygonella Michx., 1803, *sensu lat.*

CARYOPHYLLACEAE:
Plagidia Raf., 1838 = Gastronychia Small, 1933 (1) = Paronychia Mill., 1754, *sensu lat.*

LAURACEAE:
Bryantea Raf., 1838 = Neolitsea (Benth.) Merr., 1905 (75).

CRUCIFERAE:
Discovium Raf., 1819 = Lesquerella S. Wats., 1888 (80).
Oclorosis Raf., 1834 = Iodanthus Torr. & Gray, 1838 (2).

CAPPARIDACEAE:
Tarenaya Raf., 1813 = Neocleome Small, 1933 (2) = Cleome Linn. *sensu lat.*

ROSACEAE:
Chimanthus Raf., 1817 = Laurocerasus Reichb., 1828 (35) = Prunus Linn., *sensu lat.*
Eleiosina Raf., 1838 = Sibiraea Maxim., 1878 (8).

LEGUMINOSAE:
Esclerona Raf., 1838 = Xylia Benth., 1842 (11).

MELIACEAE:
Mioptrila Raf., 1838 = Toona M. Roem., 1846 (20) = Cedrela P. Browne, 1756, *sensu lat.*

EUPHORBIACEAE:
Agaloma Raf., 1838 = Tithymalopsis Klotzsch & Garcke, 1859 (40) = Euphorbia Linn., *sensu lat.*
Bivonea Raf., 1814 = Cnidoscolus Pohl, 1827 (65) = Jatropha Linn., *sensu lat.*

Lepadena Raf., 1838 = Dichrophyllum Klotzsch & Garcke, 1859 (3) = Euphorbia Linn., *sensu lat.*
Zalitea Raf., 1838 = Zygophyllidium Small, 1903 (6) = Euphorbia Linn., *sensu lat.*

STAPHYLEACEAE:
Hebokia Raf., 1838 = Euscaphis Sieb. & Zucc. "1835," *sphalm.* [1840] (2).

MYRTACEAE:
Gomphotis Raf., 1838 = Thryptomene Endl., 1838 (40).

MELASTOMATACEAE:
Alifana Raf., 1838 = Brachyotum Triana, 1867 (45).
Lomanodia Raf., 1838 = Astronidium A. Gray, 1854 (Naudiniella Krasser, 1893). (15).

ONAGRACEAE:
Meriolix Raf., 1819 = Calylophis Spach, 1835 (4) = Oenothera Linn., *sensu lat.*

UMBELLIFERAE:
Agemoron Raf., 1840 = Astrodaucus Drude, 1898 (4).
Anginon Raf., 1840 = Rhyticarpus Sonder, 1862 (5).

CORNACEAE:
Cynoxylon Raf., 1828, 1838 = Benthamidia Spach, 1839 (2) = Cornus Linn., *sensu lat.*

PYROLACEAE:
Braxilia Raf., 1840 = Erxlebenia Opiz, 1852 (2) = Pyrola Linn., *sensu lat.*
Orthilia Raf., 1840 = Ramischia Opiz, 1852 (5) = Pyrola Linn., *sensu lat.*

ERICACEAE:
Polycodium Raf., 1819 = Picrococcus Nutt., 1843 (20) = Vaccinium Linn., *sensu lat.*

PRIMULACEAE:
Borissa Raf., 1820 = Asterolinon Hoffm. & Link, 1820 (5).

SAPOTACEAE:
Spondogona Raf., 1838 = Dipholis DC., 1844 (20).
Xantolis Raf., 1838 = Planchonella Pierre, 1890 (145).

OLEACEAE:
Cartrema Raf., 1838 = Amarolea Small, 1933 (2) = Osmanthus Lour., 1790.

GENTIANACEAE:
Pleinta Raf., 1837 = Lapithia Griseb., 1845 (3) = Sabatia Adans., 1763, *sensu lat.*

ASCLEPIADACEAE:
Anthanotis Raf., 1817 = Asclepiodora A. Gray, 1876 (7) = Asclepias Linn., *sensu lat.*

CONVOLVULACEAE:
Bonanox Raf., 1821 = Calonyction Choisy, 1833 (25).
Diatremis Raf., 1821 = Pharbitis Choisy, 1833 (45).

LABIATAE:
Hyopogon Raf., 1817 = Micheliella Briq., 1897 (2).
Piloblephus Raf., 1838 = Pycnothymus Small, 1903 (1) = Satureia Linn., *sensu lat.*
Vleckia Raf., 1808 = Lophanthus Benth., 1829 (*Agastache* (Gronov.) O. Kuntze, 1891) (30).

SCROPHULARIACEAE:
Dasistoma Raf., 1819 = Brachygyne (Benth.) Small, 1903 (1).
Etornotus Raf., 1840 = Hydrotrida Small, 1913 (2) = Bacopa Aubl., 1775, *sensu lat.*
Tomanthera Raf., 1837 = Otophylla Benth., 1846 (4).

BIGNONIACEAE:
Cupulissa Raf., 1837 = Platolaria Raf., 1838 = Anemopaegma Mart., 1845 (65).

Kigelkeia Raf., 1838 = Kigelia DC., 1845 (20).
Lobonis Raf., 1838 = Sererea Raf., 1838 = Pithecoctenium Mart., 1840 (30).
Pongelia Raf., 1838 = Dolichandrone Fenzl, 1862 (20).
Potamoxylon Raf., 1838 = Couralia Splitg., 1841 (3).

OROBANCHACEAE:
Thalesia Raf., 1818 = Aphyllon Torr. & Gray, 1848 (15) = Orobanche Linn., *sensu lat.*

ACANTHACEAE:
Crateola Raf., 1838 = Oplonia Raf., 1838 = Anthacanthus Nees, 1847 (15).
Idanthisa Raf., 1840 = Anisacanthus Nees, 1842 (18).
Upudalia Raf., 1838 = Daedalacanthus T. Anders., 1864 (20).

RUBIACEAE:
Bubalina Raf., 1820 = Burchellia R. Br., 1820 (1).

COMPOSITAE:
Ptilepeda Raf., 1818 = Tetraneuris Greene, 1898 (35) = Actinea Juss., 1803, *sensu lat.*

A FEW NEW NOMENCLATURAL CHANGES

In my forthcoming Index Rafinesquianus I have deliberately proposed no nomenclatural changes. Although a glance at the tabulation above will reveal many cases where Rafinesque's generic proposals antedate currently used names of numerous other authors, I do not, in this paper or in the Index Rafinesquianus, advocate the wholesale acceptance of these early published names, although on the basis of strict priority they could be accepted. I mention above how very little this late discovery of an extraordinary large number of unlisted but validly published generic names and binomials affect nomenclature, and suggest that certain types of Rafinesque's generic names be officially rejected in favor of the currently used ones. I do not believe that all of them should be eliminated, but would rather base the selection on genera with a fairly large number of known species, and those in which economic or ornamental plants are involved. I suspect that a really critical study of the numerous cases included in the manuscript *Index Rafinesquianus* would indicate a certain number of additional cases where adjustments in species names are called for on the basis of the rule of priority or because of the homonym rule; I am convinced, however, that this number will not prove to be a very high one. This, considering the relatively early date of Rafinesque's published proposals, none later than 1840, is rather extraordinary. The very few cases where I am convinced that changes are called for are:

ARACEAE

Pothos chinensis (Raf.) comb. nov.
Tapanava chinensis Raf. Fl. Tellur. 4: 14. 1836 [1837].
Pothos scandens sensu Lindl. Bot. Reg. 16: *pl. 1337*. 1830; Benth. Fl. Hongk. 344. 1861, non Linn.
Pothos seemannii Schott, Bonplandia 5: 45. 1857, Aroid. 22. *pl. 43*. 1860; Engl. in DC. Monog. Phan. 2: 83. 1879, Pflanzenr. 21 (IV. 23B): 29. *fig. 12*. 1905.

Rafinesque's species was based entirely on Lindley's description and plate illustrating what the latter erroneously thought to be *Pothos scandens*

as cited above in the synonymy, the reference being "Pothos scandens bot. mag. 1337." The species is rather common in southeastern China extending to Formosa, and to the provinces of Szechuan and Hupeh.

ORCHIDACEAE

Phaius woodfordii (Hook.) comb. nov.

Bletia woodfordii Hook. Bot. Mag. 54: *pl. 2719*. 1827.

Phaius maculatus Lindl. in Wall. List. no. 3748. 1830, *nom. nud.*, Gen. Sp. Orch. 127. 1830–40; Hook. Bot. Mag. 68: *pl. 3960*. 1842; Hook.f. Fl. Brit. Ind. 5: 817. 1890, 6: 192. 1890, cum. syn.

Hecabe lutea Raf. Fl. Tellur. 4: 44. 1836 [1838].

The first published description of this species is apparently that of Hooker in 1827. This, with its accompanying colored plate was based on specimens cultivated in England, received from Trinidad, it having been introduced into Trinidad from Asia. It was soon considered by various other authors and several colored plates appeared, such as that of Loddiges in 1832 and of Reichenbach in 1834, and others. Three colored plates of *Bletia woodfordii* Hook. are listed and eleven of *Phaius maculatus* Lindl. The indicated range is tropical Himalaya (Nepal, Sikkim), Khasia Mountains, China and Japan.

URTICACEAE

Pellionia pellucida (Raf.) comb. nov.

Nirwamia pellucida Raf. Sylva Tellur. 35. 1838.

Frutex urticae foliis et facie . . . Niwami. Thunb. Fl. Jap. 367. 1784; cf. Nakai, Bot. Mag. Tokyo 41: 515. 1927, *in nota*.

*Boehmeria *decumbens* Thunb. ex Nakai l.c., *nom. in nota*.

Pellionia scabra Benth. Fl. Hongk. 330. 1861; Wedd. in DC. Prodr. 16(1): 166. 1869.

Rafinesque's description of the genus *Nirwamia,* with a single species *N. pellucida* Raf., was based entirely on Thunberg's ample description, the generic name derived from one of the cited Japanese names, *niwami*. Nakai, who has examined Thunberg's actual specimen is the authority for its identity with *Pellionia scabra* Benth. It is not, as Hemsley thought, the same as *Villebrunnea frutescens* Blume = *V. fruticosa* (Gaudich.) Nakai. The species is known from southern Japan to Formosa, Hongkong, Kwangtung and westward to Yunnan.

RANUNCULACEAE

Caltha auriculata (Raf.) comb. nov.

Psychrophila auriculata Raf. Atl. Jour. 1: 144. 1832.

Caltha sagittata sensu Torr. Ann. Lyc. Nat. Hist. N. Y. 2: 164. 1826, non Cav.

Caltha leptosepala DC. var. *rotundifolia* E. Huth, Helios 9: 68. 1891.

Caltha rotundifolia Greene, Pittonia 4: 80. 1899; Rydb. Fl. Rocky Mts. ed. 2, 303. 1922 [1923].

Caltha chionophila Greene, l.c.

Torrey's description is ample, and that of Rafinesque is based entirely on it. The species extends from Wyoming to Utah and New Mexico. I accept Rydberg's reduction of *Caltha chionophila* Greene.

ELAEOCARPACEAE

Elaeocarpus crenatus (Raf.) comb. nov.
Ayparia crenata Raf. Sylva Tellur. 154. 1838.
Elaeocarpus rumphii Merr. Interpret. Rumph. Herb. Amb. 349. 1917.

Rafinesque's description was based entirely on the Rumphian description of "Ayparhus," i.e. *Eyparehu, Arbor redeviva* Rumph. Herb. Amb. 3: 165. pl. 104. 1743. The species is known only from the Moluccas.

MELASTOMATACEAE

Melastoma saigonense (O. Kuntze) comb. nov.
Osbeckia saigonensis O. Kuntze, Rev. Gen. Pl. 1: 247. 1891.
*Melastoma *villosum* Lodd. Bot. Cab. 9: *pl. 853.* 1824; Sims, Bot. Mag. 53: *pl. 2630.* 1826; Cogn. in DC. Monog. Phan. 7: 356. 1891; Guillaumin in Lecomte, Fl. Gén. Indo-Chine 2: 887. 1921, non Aubl. (1775).
Plerona villosum DC. Prodr. 3: 152. 1828.
Alosemia villosa Raf. Sylva Tellur. 96. 1838.
Lasiandra villosa Naud. Ann. Sci. Nat. III. Bot. 13: 128. 1859, non Naud. op. cit. 159.
Dissotis villosa Triana, Trans. Linn. Soc. 28: 57. 1871.

This is a common species in Indo-China, extending to Siam. When it was originally described by Loddiges, and two years later by Sims, from specimens cultivated in England, it was supposed to have come from tropical South America. In Kuntze's personal collection of *Osbeckia saigonensis* on which his description was doubtless based, the name *saigonensis* is indicated as of varietal status. Curiously this specimen is not cited by him, except by inference, his entry being: "Saigon. Auch von Godefroy Leboef dort gesammelt." Clearly the long-used specific name *villosum* is invalid because of the earlier and very different *M. villosum* Aubl. (1775) which belongs in *Tibouchina*. Guillaumin, l.c., inadvertently added another synonym in "*Pterotoma*" *villosa*, there being no such a generic name as *Pterotoma;* this is manifestly a misprint for *Plerona villosum* DC.

CLETHRACEAE

Clethra grisebachii nom. nov.
Clethra bracteata Griseb. Fl. Brit. W. Ind. 141. 1859, non Raf. (1838). Jamaica.

PRIMULACEAE

Dodecatheon pulchellum (Raf.) comb. nov.
Exinia pulchella Raf. Aut. Bot. 185. 1840.
Dodecatheon integrifolium sensu Hook. Bot. Mag. 64: *pl. 3622.* 1837, non Michx.
Dodecatheon meadia Linn. var. *pauciflorum* Durand, Jour. Acad. Nat. Sci. Phila. II. 3: 95. 1855.
Dodecatheon pauciflorum Greene, Pittonia 2: 72. 1890; Pax & Knuth, Pflanzenr. 22 (IV. 237): 242. 1905; Rydb. Fl. Rocky Mts. 654. 1918.
Meadia pauciflora O. Kuntze, Rev. Gen. Pl. 1: 398. 1891.

Exinia Raf., with a single species *E. pulchella* Raf. was based wholly on Hooker's illustration and description of what the latter erroneously assumed to represent *Dodecatheon integrifolium* Michx. Hooker's

material was from Carleton House Fort (Saskatchewan), and the Rocky Mountains, his illustration based on plants grown from seeds collected by Drummond in the Rocky Mountains. Greene gives the range as extending to Montana, Wyoming, Colorado and New Mexico; Rydberg indicates it as extending from the Mackenzie region and Saskatchewan to British Columbia, Washington and Colorado.

ACANTHACEAE

Mendoncia bivalvis (Linn.f.) comb. nov.

Besleria bivalvis Linn. f. Suppl. 280. 1781.
Drupina cristata Linn. Pl. Surinam. 11. 1775, Amoen. Acad. ed. Schreber 8: 259. 1785, *nom. nud.*
Picria surinamensis Spreng. Syst. 2: 843. 1826.
Senkenbergia debilis Raf. Sylva Tellur. 70. 1838.
Mendoncia perrottetiana Nees in DC. Prodr. 11: 53. 1847.

I do not consider that *Drupina cristata* Linn. is validly published. It appears first in Alm's dissertation *Plantae Surinamenses* 11. 1775 merely as "Drupina 148. *cristata.* Herba sesquipedalis simillima Besleriae cristatae." This is repeated in Schreber's edition of the *Amoenitates Academicae* 8: 259. 1785. I have found no published description of either the genus or the species. A footnote in the *Amoenitates Academicae* reprint reads "82. Besleria bivalvis, *Suppl.* 280" which explains this disposition of the binomial. This reduction is further verified by the data on the type sheet of *Besleria bivalvis* Linn. f. and the entry in Savage's *Catalogue of the Linnaean Herbarium,* p. 106. 1945: "Besleria 2 148. [*Pl. Surin. p. 11. n. 143.*] Drupina cristata. [Sm:] *Pl. Surinamenses* [*Ms.*] *No. 82. Besleria* **bivalvis Supp.**" Currently the generic name *Drupina* Linn. is placed by De Dalla Torre and Harms as a synonym of the gesneriaceous genus *Besleria* Linn., but they also entered it as a doubtful synonym of the scrophulariaceous genus *Curanga* Juss. *Senkenbergia* Neck. is placed as a synonym of *Justicia* Linn., but as interpreted by Rafinesque it belongs with *Mendoncia.* It is difficult to explain how Sprengel, who, of course, saw no specimen, could place the species under *Picria* Lour. (1790) = *Curanga* Juss. (1807), *Picria surinamensis* Spreng. being merely a new name for *Besleria bivalvis* Linn. f.; *Senkenbergia debilis* Raf. was also based wholly on the same binomial. The specimen in the Linnaean herbarium is an excellent one, type from Surinam (Dutch Guiana), and an examination of an excellent photograph of it shows clearly that it is identical with *Mendoncia perrottetiana* Nees, the type of which was also from Surinam.

SOLANACEAE

Acnistus campanulatus (Lam.) comb. nov.

Cestrum campanulatum Lam. Encycl. 1: 688. 1785.
Lycium aggregatum Ruiz & Pavon, Fl. Peruv. 2: 45. 1799.
Perderlea agregata Raf. Sylva Tellur. 54. 1838.
Perderlea cestroides Raf. l.c.
Acnistus aggregatus Miers in Hook. Lond. Jour. Bot. 4: 341. 1845.

This Peruvian species is apparently distinct from the West Indian and and Central American *Acnistus arborescens* (Linn.) Schlecht., although Schlechtendal, Linnaea 7: 67. 1832, placed the binomials of Lamarck and of Ruiz and Pavon in the synonymy of that species. Lamarck's type was from Peru, and Schlechtendal notes that the Dombey specimen which Lamarck had bears the same vernacular name as that cited by Ruiz and Pavon.

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AMBORELLA TRICHOPODA BAILL.
A NEW TYPE OF VESSELLESS DICOTYLEDON

I. W. Bailey and B. G. L. Swamy

In 1900, at the conclusion of his discussion of the eight known genera of the Homoxyles, Van Tieghem* made the following prophecy: "Ce groupe étant ainsi établi, il est probable que les découvertes ultérieures y introduiront peu à peu de nouveaux membres. Il est possible aussi que ces nouveaux membres offrent les divers types d'organisation florale qui n'y sont pas encore représentés. L'example due Tétracentre, qui n'est connu que depuis douze ans, est instructif sous ce rapport et autorise toutes les espérances."

During the last 46 years, in extensive investigations of extant angiosperms, no new types of large, perennial, vesselless dicotyledons have come to light. Even in the paleobotanical field, vesselless woods, that have been described from India (Jurassic ?), Western North America (Tertiary) and Greenland (Eocene), apparently are anatomically indistinguishable from the secondary xylem of the living *Trochodendron* and *Tetracentron*. It is of considerable general botanical interest, therefore, that the New Caledonian endemic, *Amborella*, proves to be a new type of vesselless dicotyledon.

A detailed morphological discussion of this remarkable plant will appear in a forthcoming issue of this Journal.

* Tieghem, P. van. Sur les dicotylédones du groupe des Homoxylées. Jour. de Bot. 14: 361. 1900.

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JOURNAL
OF THE
ARNOLD ARBORETUM

VOL. XXIX JULY 1948 NUMBER 3

DISTRIBUTION AND OCCURRENCE OF WHITE PINE (*PINUS STROBUS* L.) AND RED PINE (*PINUS RESINOSA* AIT.) AT THE NORTHERN LIMIT OF THEIR RANGE IN ONTARIO

W. R. HADDOW *

With three plates

INTRODUCTION

IT IS MORE THAN FIFTY YEARS since Robert Bell published the last of his several papers (2, 3, 4) on the distribution of forest trees in eastern Canada, and laid down on a map his final representation of the northern limits of the principal species east of the Rocky Mountains.[1] In the interim, knowledge and understanding of the forests of eastern Canada have been greatly advanced, thanks to exploration and the progress of research in several fields; but little has been added in the literature to what Bell said concerning the actual geographical distribution of forest trees, especially at the northern limits of range.[2] His work in that field remains the principal source to which are indebted the authors of standard and popular works published since the beginning of the century.

* The author has compiled a check list of stations for white pine and red pine at the northern limit of their range in Ontario, published in 1948 and cited as (12) in the bibliography accompanying the present paper. Through the kindness of the Ontario Department of Lands and Forests, separates of the check list are available and will be mailed to subscribers to the Journal of the Arnold Arboretum.

1 Bell's first contribution was a map, the first of its kind in Canada, which showed the northern limits of the principal timber trees in the original Canadian provinces. That map was published in 1879 under the authorship of A. T. Drummond (6); but according to the latter is attributable to Bell and Drummond jointly. According to Bell (4) it was drawn originally by him in 1873. It was used by the Canadian Department of Public Works in the preparation of the first official tree range map in Canada.

2 Reference is made to the presentation of authentic distributional data. In 1905 Transeau (14) showed on a map, by means of varying depth of shading, the extent and overlapping of the ranges of several conifers in the northeast, but he did not record any new stations. Later (15) he illustrated the ranges of red and white pine on

Was Bell's work truly exhaustive? No great change could be made in the position of the tree lines on his map. His account of isolated and rare occurrences of several species, remarkable in itself, remains of interest and value to-day, — the more so since some of the stations described have already disappeared, and others are threatened by exploitation. But Bell recognized that his account of distribution was far from complete in detail, and that his map might even be misleading in part. Thus he said that the tree lines were "general boundaries," and that occasional or "chance" trees were known to occur beyond them. Again, he remarked on the extraordinary scarcity of stations at some places within the lines, and expressed doubt as to where the boundary should be placed. In thus picturing the broad configuration of the northern limits of distribution, the true character of the boundary zone was not represented. That character is of prime importance and is highly significant in the interpretation of vegetation dynamically.

In the course of exploration and development of the country since the beginning of the century, many new and relevant observations of tree occurrences have been made, which together comprise an important body of distributional data. These for the most part have failed to find their way into print, or have remained isolated and inaccessible, without benefit to the literature of forest geography. A notable contribution, however, was made by Halliday and Brown (8), who introduced new data and employed a novel method of illustrating the distribution of some of the principal Canadian forest trees. One of their aims was to show the relative importance (abundance) of each species throughout its range. For that purpose population density class maps were prepared from a large body of timber cruise data; but having few for red and white pine deemed suitable for their purpose, those species were not dealt with.

That omission was doubtless warranted, for exploitation over a period of two hundred years has greatly modified the natural distribution of red

small maps by means of dots; but for northern Ontario his representation was purely conventional. In detailed studies in Ontario relating to distribution, Hutchinson (9) did not present new geographical knowledge. His tree lines were essentially those of Bell. Sudworth (13), in his atlas covering *Pinus,* showed the distribution of each species by a field of solid colour. In a commentary, Fernow (7) criticized the "scalloped outline on the outskirts" of the field representing the distribution of white pine, and queried whether certain discontinuous parts were truly representative, or merely suggestive. Moreover, he stated that ". . . what is really much more needed, and would prove of exceeding value, is the detail distribution on a large scale map, even if it were of only a limited number of species, and especially of their outskirts, when the ecology of the species could be brought out with more satisfaction." In 1938 Munns (11) prepared distribution maps after the manner of Sudworth, by compiling "reliable information from many sources," published and unpublished. For red and white pine, which were pictured separately, the northern limits in Ontario were approximately as shown in the Dominion government atlas maps published in 1906 and 1915. These had departed slightly from Bell's map in showing red pine farther north than white pine, as had been suggested in Bell's text. In 1941 the Ontario Department of Lands and Forests published an atlas containing a map showing tree lines in the province (1). Recently a compilation of the data which are the basis of the present study was issued by the same service (12).

and white pine quantitatively throughout a large part of the range of those species. Their northern limits in Ontario, however, have remained comparatively undisturbed until recently; and for the parts where logging has encroached there, data representing virgin conditions are available.

Actually red and white pine offer peculiar advantages for distributional study. Their large size renders them comparatively conspicuous in the northern forest. Moreover their commercial value has been the cause of their being reported carefully and regularly in explorations and surveys under government supervision from the earliest days to the present time.

In view of the above it seemed both appropriate and feasible to undertake a detailed investigation of the distribution of red and white pine at the northern limit of their range. The following pages comprise the results of such study in the province of Ontario.

METHOD AND SOURCES

Common knowledge suggested the preliminary definition of a base line or datum beyond which the occurrence of red and white pine might be taken to be local, sporadic, or rare. That line was chosen as follows: — From the Quebec boundary westward along the height of land between the St. Lawrence and James Bay waters to the height of land portage on the Michipicoten–Missinaibi route to Moose Factory; thence southwesterly along that route to Michipicoten and westerly along the shore of Lake Superior to the head of Black Bay; thence along the north boundary of the township of Dorion and its projection due west through Dog Lake to the Canadian National railway, and along that line through Sioux Lookout and Kenora to the Manitoba boundary.

All reliable records of occurrence of white or red pine north of that line known to the writer have been assembled elsewhere (12), and are plotted on the maps herewith. For these data I am indebted principally to the reports of land surveyors, who, since the beginning of government administration in Ontario, have carried out explorations, meridian and base line surveys, township subdivisions and lake and river traverses on the Crown lands. As already indicated, in the course of that work they regularly described the forest conditions, and in particular noted the occurrence of red and white pine timber. To their reports have been added unpublished records derived from personal observation and information received from correspondents. For the latter I am indebted chiefly to associates in the Department of Lands and Forests, especially to Messrs. J. Barron, R. Boultbee, J. A. Brodie, W. D. Cram, Q. Hess, H. Hills, T. E. Mackey, W. J. Robinson, J. Ruxton, R. Taylor, and B. Wilson.

In assembling the records and in plotting them, it was necessary to distinguish "stands" from "scattered trees," and from "single" or "isolated" trees. Admittedly the distinction between those classes was not always an easy one to make. In general a "stand" represents a community (*Pinetum*), while "scattered trees" represents occurrence where from the

station occupied by the observer, several to many widely separated individual trees could be seen. Some of those trees may have been virtually isolated. "Single" or "isolated" occurrences are those where one, or not more than seven trees in a group were found remote from other specimens. Veritable single tree occurrences, of which a number are known, are recorded elsewhere (12).

For the most part these reports antedate forest exploitation in the regions concerned. The picture of distribution given may be taken therefore as representing virgin conditions.

DISCUSSION

Occurrences of white and red pine north of a line already described are plotted on maps herewith. The actual distribution of those species there is seen to be referable to eastern and western sectors, the region north of the central part of Lake Superior being virtually without occurrences. The few known stations for red pine there are rightly regarded as isolated and quite exceptional.

In the western sector both red and white pine range considerably farther north than in the east. There, too, in the peripheral zone as generally, red pine is much commoner than white pine; while in the east (and in the Nipigon area) the reverse is true. The relative abundance of red pine increases toward the north throughout.

The general configuration of the northern limit of distribution parallels the yearly isotherms and is related to the length of frost-free period. Thus the region to the north of Lake Superior, which is apparently not unfavourable for pine edaphically, has a shorter frost-free season than contiguous areas to the east and west. Similarly, in the sector outlined by the limit of pine west of Lake Superior, spring comes two weeks earlier than farther north and east.

Within the selected border zone pine is almost everywhere sporadic or rare; but its frequency of occurrence varies in different parts, as can be shown quantitatively. If by "occurrence of pine" is meant the report of occurrence, whether of stand, scattered trees or single trees, the rate of occurrence per thousand square miles may be stated approximately for different regions as follows:

Region	*Rate of occurrence of pine per 1000 square miles*
District of Sudbury north of the height of land	22
Districts of Temiskaming and Cochrane north of the height of land as far north as town of Cochrane	8
District of Algoma north of Michipicoten	5
Territory west of Lake Nipigon north of a selected line	3

The above frequencies indicate that isolation and disjunction, increasingly significant toward the north, characterize the distribution of white and red pine throughout the whole of the area considered. The depth of the zone in which pine is sporadic or rare is generally more than one hundred miles.

In the east the principal concentrations of pine north of the height of land were originally in the area bordering Lake Mattagami and the parallel waters of Grassy River, including Kapiskong, Nursey, and Sinclair Lakes. That country was referred to in a general way by Cavana and Watson in 1911 as "a locality eminently suited to the growth of red and white pine, but this timber is not greatly in evidence." It continues to supply to this day, however, some pine logs for the mills at Timmins.

There is also a noteworthy concentration of pine in scattered stands in the vicinity of Horwood Lake, some of which remains. That region was described by Speight and van Nostrand in 1907 as "the most promising for white and red pine that we have seen in the James Bay watershed."

The township of Frater, too, originally contained a considerable amount of red and white pine timber. Farther west, fires have possibly obliterated evidence of pines in historical times; but the known occurrence of scattered veterans in the country north of Chapleau suggests a former concentration there. Similarly, pine occurrence is indicated west of Missinaibi, in the vicinity of Manitowick Lake, though few trees remain there now.

A few noteworthy stands of red pine are known even farther north in the district of Algoma. A well known one on the portage from Oba River to Kabinakagami Lake, in Derry Township, which was first reported by Baird in 1900, still remains. But that one which formerly stood where the railway now crosses the Kabinakagami River is gone completely. It furnished convenient piling for the numerous trestles built during railway construction.

On the Nipigon drainage, a considerable amount of pine has been cut, and some remains. One of the principal stands was possibly that which formerly stood in the vicinity of Pine portage on the Nipigon River, which was described by Herrick in 1860. Other concentrations occurred in Innes Township, where until recently red pine stood on the shore of Lake Nipigon. Around Kabitotikwia and Black Sturgeon Lakes, remnants of once fairly extensive stands, principally of white pine, can still be found.

In the peripheral zone west of Lake Nipigon, it is scarcely possible to recognize concentrations of pine. Occurrences of both species are extremely rare and widely scattered. There are stations for white pine on Sturgeon Lake, lac Seul, Pakwash and Red Lakes; and for red pine on Savant Lake, Lake St. Joseph, Red Lake and Nungesser Lake. Perhaps the chief centre for white pine was around the west end of Sturgeon Lake. Both species are scattered here and there on the shores and islands of the central part of lac Seul. The largest stand of red pine is on Thaddeus Lake, near lac Seul.

In the northern clay belt area, the principal concentration of white pine (with considerable red pine, too) was undoubtedly that which formerly covered the sand hills in Dundonald and Evelyn Townships, near Frederickhouse Lake. A smaller stand of fine quality occurred in the township of Edwards some distance to the northeast. The principal stand of red

pine, long since cut, was at the outlet of Abitibi Lake, in the township of Kerrs. There was formerly a small stand of red pine on a point of land extending into a lake near the central part of Alexandra Township. A remarkable grove, the most northerly known in these parts, still stands on the shore of Lake Montreuil in Swartman Township.

Although white and red pine are already comparatively rare and of sporadic occurrence in the forest some distance south of the northern clay belt, they are found much less frequently once that area is entered. Yet it is noteworthy that both species penetrate it deeply and are found at widely scattered stations where soil conditions are favourable. In the Temiskaming clay belt, however, pine was originally much commoner than in the northern one.

Within the so-called clay belt areas, the extensive clay and silt deposits are generally unsuitable for the growth of pine, especially as compared with spruce, with which it must compete. When pine occurs it is found on sandy or gravelly deposits, on rocky hills or on occasional rocky shores of lakes and rivers, and on islands. The deep extensive morainic deposits in Dundonald and Evelyn Townships must have stood as islands in glacial Lake Ojibway. Smaller deposits, evidently of fluvio-glacial origin, appear to have been water-washed to sandy and gravelly bars of scarcely perceptible elevation. On such sites both red and white pine have been found. For the most part, however, red pine occurs on the coarser gravels of eskers and kames, especially where they protrude as sharp points or hog's backs into lakes.

The two species differ considerably in their sociability. Red pine is usually gregarious, even at the extreme limit of its range. The stands, however, are small, often comprising only a few acres or less. They usually appear to be roughly even aged, though poles, saplings and smaller trees are not unknown, especially at the margins of mature groves. In the case of white pine, occurrence is typically "scattered" or "scattering" — adjectives that recur in the field notes with monotonous frequency. Such trees are often virtually isolated individually, and certainly do not any longer represent a pine community. Usually large and overmature, though cones are borne from time to time, they are not replaced when they fall. That such trees sometimes represent a former pinery is evident from the presence of stubs and fallen timber in various stages of decay. The approximate even age of the timber left suggests, too, a common origin for all.

Scarcity of young pines, especially white pine, is strikingly characteristic throughout the northern boundary zone. While it is probably true that observation and reporting have not been as satisfactory for small trees as for large ones, the reports undoubtedly reflect an actual dearth of reproduction. Young trees, which were taken as trees reported in the notes as young, small, or less than twelve inches in diameter, were noted only twenty-five times in a total of three hundred and seventy-one pine observations.

That white pine formerly occupied areas where it is now entirely absent is evident from some early survey reports. According to McAree, the township of Homer, in the district of Thunder Bay, contained no standing pine when he surveyed it in 1872; but he said that charred stumps of white pine and cedar of large size were all through the woods, the country having been burned over fifty or sixty years earlier. Similarly, McAuslan and Anderson, reporting on Nassau and Storey Townships in 1915, found no pine there at that time, but said that much of the land had formerly been timbered with cedar and white pine, which had been destroyed by fire and succeeded by spruce. A few scattered specimens of white pine still standing in Langemarck and Dowsley Townships, and the two single trees recently found in Rogers and Studholme Townships, are possibly remnants of a once extensive forest in which that species was well represented. Again, there is at least the suggestion that white pine (or possibly red pine) formerly occurred in Chipman and O'Meara Townships northeast of Longlac. The lake in those townships shown on map No. 23a Province of Ontario, as "Chipman Lake" was formerly known locally as "Pine Lake" and was thus marked on a map published by the Crown Lands Department in 1901. The reference would hardly be to jack pine. Attention may be drawn here to Bell's report of stories to the effect that white pine once extended considerably farther north along the principal tributaries of the Moose, but that it had been destroyed by fire there and was succeeded by other species.

This picture of actual distribution suggests decadence and retreat. Isolation is evidently acting here against reproduction, and therefore as a barrier to migration. For these scattered trees are almost certainly self-fertilized, which for white pine results in seedlings of comparatively low vigour; and for red pine in a reduction of the amount of seed set, as shown experimentally by Johnston (10). These handicaps contribute to failure in competition with other species, to which white pine especially is exposed.

On the other hand it cannot be denied that some few white pines have grown as isolated pioneers in new localities. Thus a single tree, now gone, which formerly stood on an island in the Mattagami River in Harmon Township, was almost certainly a pioneer from seed brought with flood wood from the headwaters of the river. Standing twenty miles from its nearest neighbors (a group of five old pines on another watershed, themselves thirty miles or more from any other known station) it is significant, perhaps, that the tree failed to reproduce itself. The extraordinarily rare occurrence of three young white pines, some twenty feet high, on top of a rocky bluff overlooking Penelton Lake in Opazatika Township, is harder to account for.

It is of interest to speculate on the origin of the forest biota populating the zone in which red and white pine now find their northern limit. From what source or sources have they been derived, and what has been the direction and chronology of migratory movement? It is evident that the

concept of migration from remote refugia is valid only in its broadest application. The evolution of the glacial lakes precluded the possibility of a uniform advance in the wake of the ice; — water coverage has played a role no less important than ice coverage, locally, in the history of revegetation in northern Ontario. Thus the western area of the province, except below the level of Lake Agassiz, has been exposed throughout the relatively long period of Algonquin time, and subsequently. On the other hand, farther east Algonquin waters covered most of the present "compact" area of pine distribution in the upper lakes drainage in Ontario until comparatively recently. But the surface of Lake Algonquin was not uninterrupted. Besides the great Pukasaw promontory which Coleman (5) thought was exposed, large land masses to the east, well over 1500 feet above sea-level, must have stood as islands in the lake. The largest of them, an area of some twelve hundred square miles, centres on the upper waters of the Mississagi River. Another highland area of some two hundred and fifty square miles lies at the headwaters of the Montreal and Chapleau Rivers. These and smaller areas were well situated to reforest the bed of Lake Algonquin as the waters receded to the Nipissing Great Lakes levels. That forests existed on the north shore of Algonquin can scarcely be doubted. Their character is suggested by the deposits of flood wood that Coleman (5) found near Michipicoten, which he said were probably of Algonquin age, and certainly older than the Nipissing Lakes. They contained trunks recognized as poplar, cedar, balsam, white and black spruce, jack pine and white pine.

SUMMARY

This study is based on a summary report and analysis of all the records known to the writer of the occurrence of white and red pine north of a specified line in Ontario (12). It comprises a map showing the location and character of the stations, and a discussion of the actual distribution and mode of occurrence of those species at the northern limits of their range in the province.

The base line selected was the height of land between the Great Lakes and James Bay from the Quebec boundary westerly to a point near Missinaibi; thence to Lake Superior at Michipicoten and along the shore to the head of Black Bay; thence westerly to the Canadian National railway and along that line to Sioux Lookout and the Manitoba boundary.

The distribution of white and red pine north of that line is seen to be referable to eastern and western sectors. In the region north of the central part of Lake Superior stations for white pine are unknown, and red pine is exceedingly rare. In the western zone red pine is commoner than white pine, while in the east and in the Nipigon area the reverse is true. The relative abundance of red pine increases toward the north throughout.

Red pine occurs typically in small stands on the coarser glacial deposits; white pine is usually scattered and is less selective with respect to site. Reproduction is exceedingly scarce, especially in the case of white pine.

The depth of the peripheral zone, in which white and red pine are sporadic or rare, appears to be generally more than one hundred miles. Within that zone many stations are virtually isolated and self pollination of the trees must be the rule. Early survey reports record the occurrence of pine at stations where it is now absent. The present condition of many white pine stands suggests that they are decadent.

The history of the glacial lakes in northern Ontario has been of prime significance relative to the actual distribution and age of the forests there. Highland areas, available for colonization at a relatively early date, have been forested much longer than the areas covered by the waters of Lakes Algonquin and Ojibway, and have doubtless contributed to the vegetation of the latter.

ACKNOWLEDGMENT

This study was supported by the Department of Lands and Forests, Province of Ontario. The writer is especially indebted to the office of the Surveyor General for access to survey records and for the preparation of map figures, and to correspondents named in the text who provided personal information.

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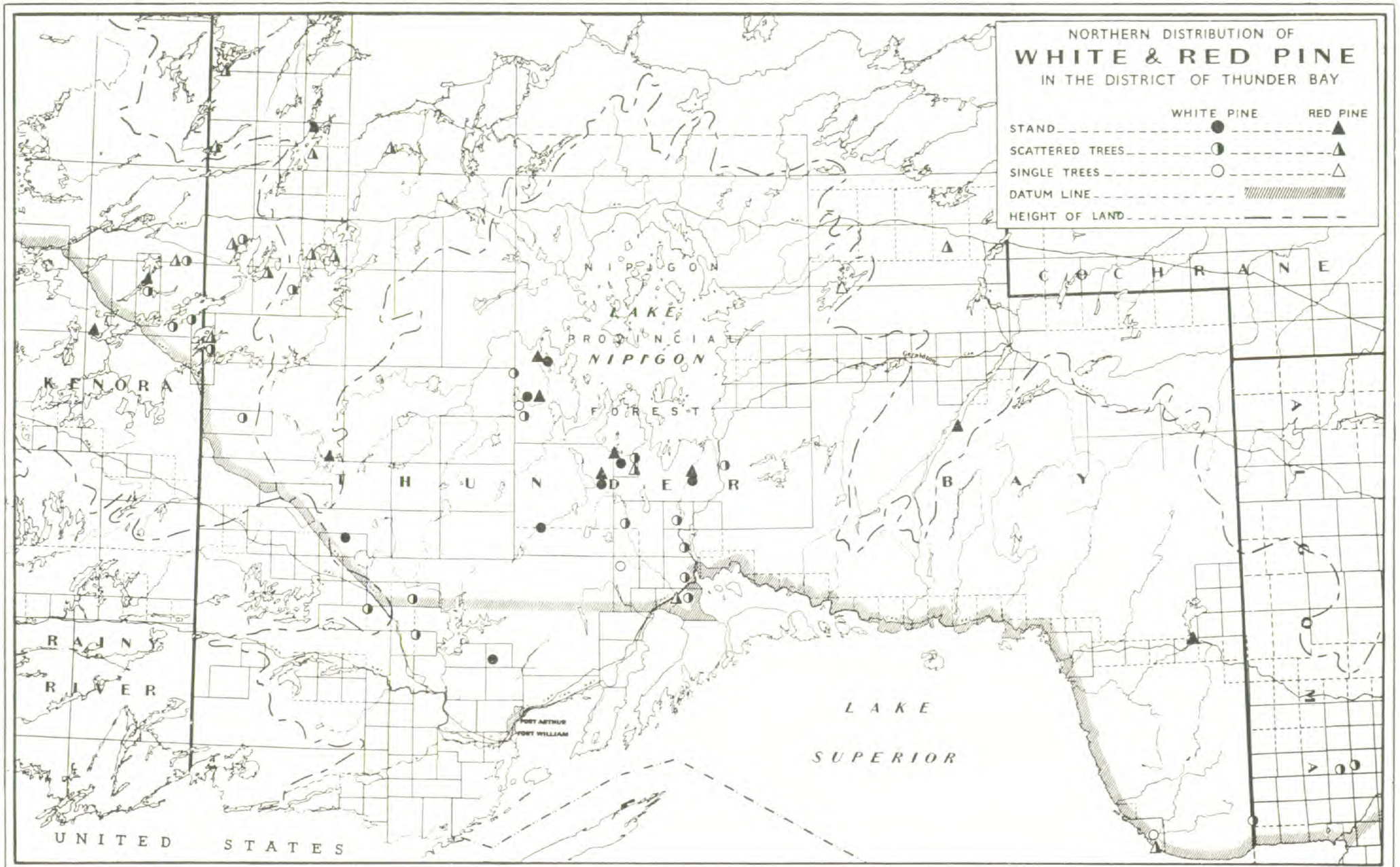
EXPLANATION OF PLATES I, II, AND III

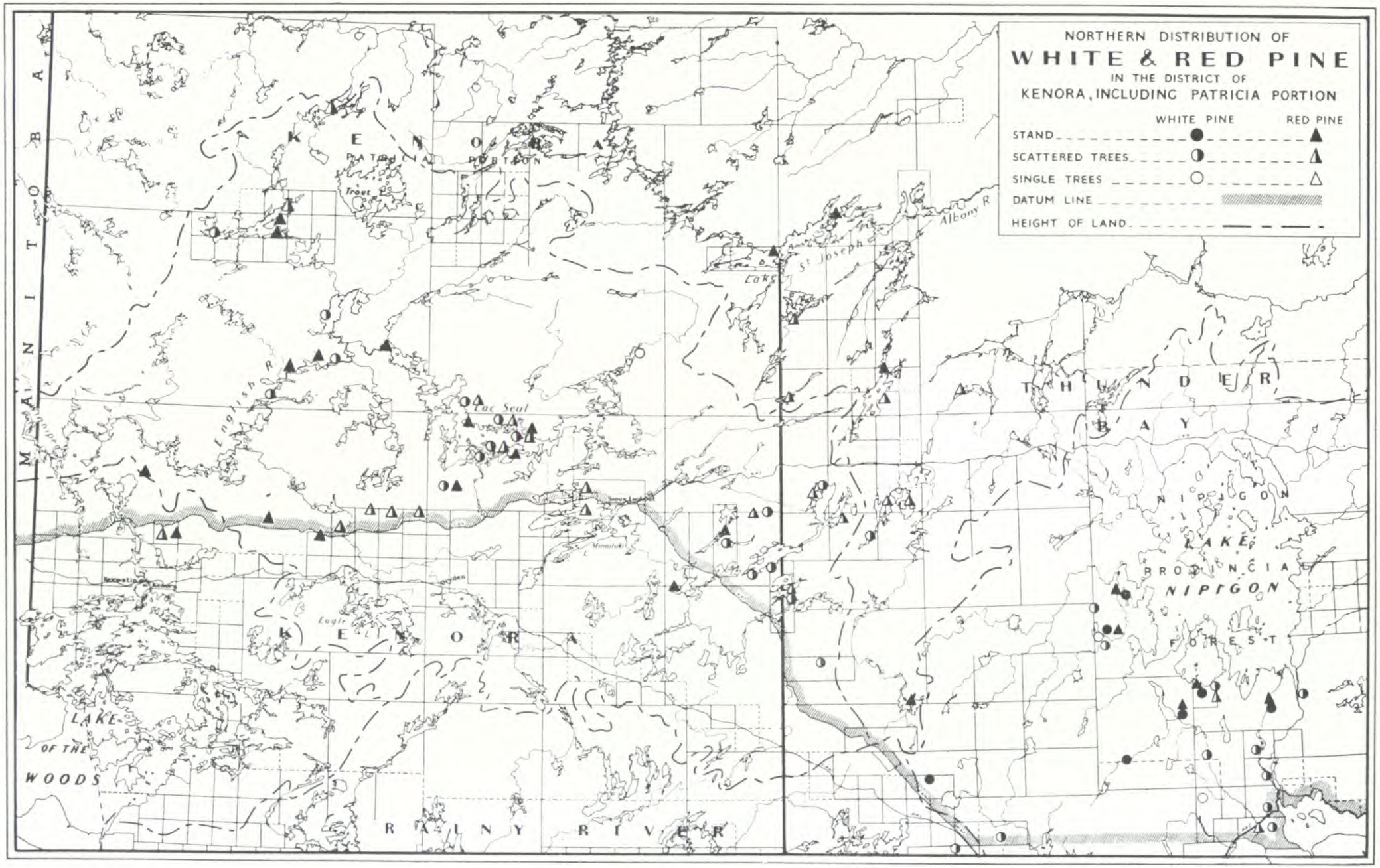
Distribution of white pine and red pine at the northern limit of their range in Ontario. Eastern, central, and western parts respectively. Scale: 48 miles = 1 inch.

DEPARTMENT OF LANDS AND FORESTS,
TORONTO, ONTARIO, CANADA.

Distribution and occurrence of white pine and red pine



DISTRIBUTION AND OCCURRENCE OF WHITE PINE AND RED PINE



DISTRIBUTION AND OCCURRENCE OF WHITE PINE AND RED PINE

STUDIES IN THE BORAGINACEAE, XVI *
SPECIES CHIEFLY FROM MEXICO AND WESTERN UNITED STATES

IVAN M. JOHNSTON

Cordia coyucana, sp. nov.

Frutex 3 m. altus ramosus; foliis 4–7 cm. longis 1.5–3 cm. latis 3–5 mm. longe petiolatis saepe infra medium latioribus, apice acutis, basi acutis obtusisve, margine in tertiam partim inferiorem integris alibi evidenter dentatis (dentibus 0.3–1 mm. altis), supra viridibus subvelutinis pilos majores gracilis mollis 1–2 mm. longos ascendentis basi incrassatos et pilos perinconspicuos minutos basi conico-incrassatos gerentibus, subtus griseis tenuiter tomentosis evidenter costatis et nervatis; inflorescentia capitato-congesta in ambitu elliptica densissima ca. 50-flora maturitate 10–13 mm. crassa 15–25 mm. longa; pedunculo 3–4 cm. longo extra-axillari e latere caulis erumpenti; calyce ad anthesin 4–5 mm. alto hispidulo, lobis triangularibus 1 mm. longis 1–2 mm. latis acutis nullo modo appendiculatis; corolla alba 6 mm. longa extus glabra intus in tubo villulosa, limbo ad 5 mm. diametro, lobis ca. 2 mm. longis et latis apice emarginatis margine crispatis; filamentis ca. 3 mm. supra basim corollae affixis ca. 2 mm. longis.

GUERRERO: Coyuca, shrub 3 m. tall, on hill, 1935, *Hinton 8156* (TYPE, Gray Herb.).

A very well marked species of the Section *Varronia*. It is readily distinguished from all known species by the following combination of characters: large very dense ellipsoidal capitate-congested pedunculate inflorescence, indument of simple (non-stellate) hairs, unappendaged calyx-lobes, and small corollas. None of its congeners in Mexico or Central America seem closely related to it.

Cordia passa, sp. nov.

Planta laxa suffruticosa; ramis fruticosis gracilibus, juventate foliosis simplicibus 5–15 cm. longis 1–1.5 mm. crassis ascendentibus e caudice ramos procumbentis efoliatos composito erumpentibus; foliis 3–10 mm. distantibus 2–15 mm. longe petiolatis; lamina 15–55 mm. longa 5–30 mm. lata infra medium latiore, basi obtusa vel acuta, apice acuta, margine utroque conspicue 5–8-dentata, subtus grisea (pilis 0.2–0.7 mm. longis e basi pustulata inconspicua erumpentibus donata) utroque latere costae nerviis evidentibus ca. 5 donata, supra viridi hispidula (pilis ascendentibus ad 0.5 mm. longis e basi pustulata inconspicua erumpentibus donata); pedunculo extra-axillari 0.5–3 vel rariter ad 7 cm. longo; inflorescentia capitata densa 10–25-flora corollis exclusis 0.8–1.2 cm. diametro; calyce sub anthesi ad 5 mm. longo, lobis 2.5–3 mm. longis 1.2–1.5 mm. latis sparse hispidulis e basi sursum gradatim attenuatis apice viridibus subliberis; corolla alba infundibuliformi 2.5–2.8 cm. longa, limbo ad 2 cm. diametro, tubo parte inferiore 1 cm. longo 1–1.5 mm. crasso deinde sursum gradatim ampliato, lobis emarginatis ca. 8 mm. latis et 4 mm. longis; filamentis ad 5 mm. longis, antheris ad 1 mm. longis.

* No. XV in this series was published in this Journal, **21**: 336–355. 1940.

TAMAULIPAS: Near San Lucas, Jaumave, July 1932, *Rozynski 563*. HIDALGO: Jacala, mountainside, 4500 ft., July 1939, *Chase 7461* (TYPE, Gray Herb.); Jacala, dry trailside at top of east wall of Barranca Seca, between Hilo Juanico and Pacula, fl. white, alt. 1400 m., Oct. 1946, *Moore 1823*. INDEFINITE: *Coulter 1332*.

A relative of *C. podocephala* Torr. of northeastern Mexico and adjacent Texas and occupying an area just south of that species. It is a sprawling plant with a large slender-tubed funnelform corolla with short broad lobes. Its calyx has a somewhat acuminate apex formed of the partially free tips of the lobes. On the other hand, *C. podocephala* is an erect-growing plant. Its smaller corollas have a short tube and a deeply lobed limb, and its calyx-lobes have no free tips. Though related, the species are undoubtedly distinct.

Bourreria Hintonii, sp. nov.

Frutex; ramulis horni ad 1.5 mm. crassis et 15 cm. longis pilulos rigidulos adpressos sparsissimos perinconspicuos 0.1–0.4 mm. longos gerentibus; foliis obovatis vel obovato-oblanceolatis 2.5–6 cm. longis 1–3 cm. latis supra medium latioribus deinde deorsum in petiolum 2–4 mm. longum supra sparse minuteque hispidulum attenuatis, margine anguste revolutis, subtus glaberrimis nullo modo asperatis, supra scabridis pilos sparsos inconspicuos rigidos perbrevis antrorse ascendentis basi silicosa erumpentis proferentibus, nervis primariis utroque latere costae subtus prominentis supra infra medium impressae prominulis 5–7 cum nervis secondariis et tertiariis conjunctis; cymis 5–10 mm. longe pedunculatis breviter furcatis sparsifloris; calyce 7–9 mm. longo, basi ca. 2 mm. crasso breviter crasseque substipitato, apice 3–4 mm. crasso, extus fere glabro sub lente pilis minutis sparsissimis praedito, intus supra medium plus minusve striguloso, lobis inaequalibus 2–3 mm. longis 1–1.5 mm. latis acutissimis erectis; corolla alba 2 cm. longa, limbo ca. 14 mm. diametro, lobis rotundis 5–6 mm. longis ad 5 mm. latis supra glandulis substipitatis minutissimis sparse praeditis extus sub lente glandulis et pilulis minutissimis sparse obsitis; tubo calycis 10–12 mm. longo basi 2 mm. crasso, apice ad 5 mm. crasso, intus glabro, extus apicem versus sparse minuteque glandulifero; antheris subexsertis 4 mm. longis; filamentis glabris 4 mm. longis ca. 3 mm. infra sinus affixis; ovario glabro; fructu ignoto.

GUERRERO: San Luis, dist. Galeana, shrub by beach, also a tree inland, fl. white, Oct. 1937, *Hinton 10866* (TYPE, Gray Herb.).

A well-marked species of uncertain affinities. Among its notable features are its moderately small leaves very scabrous above, its sharply toothed elongate calyx strigose only inside and merely substipitate at base, its glabrous filaments, and its elongate exserted corolla-tube.

Bourreria longiflora, sp. nov.

Arbor 10 m. alta; foliis glaberrimis ellipticis 5–11 cm. longis 3–6 cm. latis 8–20 mm. longe petiolatis ubique obtusis supra sublucidis subtus opacis, nervis primariis utroque latere costae subtus prominentis ca. 9 prominulis cum nervis secondariis et tertiariis transverse conjunctis; cymis 3–10-floris congestis apice ramulorum 1–5 cm. longorum extra-axillarum paucifoliatorum gestis, bracteis ovatis ad 8 mm. longis deciduis conspicue ciliatis; calyce sub anthesi campanulato ad 8 mm. longo extus glaberrimo intus supra medium dense conspicueque albo-villuloso, lobis triangularibus

acutis 2.5–3 mm. longis 2 mm. latis; corolla alba odorata ca. 25 mm. longa glaberrima, tubo ca. 20 mm. longo a basi 3 mm. crasso sursum gradatim ampliato apice 7–9 mm. crasso, faucibus haud differentiatis, lobis circularibus ca. 6 mm. diametro ascendentibus limbum ca. 15 mm. diametro formantibus; staminibus exsertis, filamentis 20–25 mm. longis ca. 6 mm. supra basim tubi affixis infra medium evidente villulosis; antheris 4 mm. longis medio affixis; fructu ignoto.

MICHOACAN: Tizupan, dist. Coalcoman, tree 10 m. tall, in barranca, fls. white, sweet-scented, 1941, *Hinton 15908* (TYPE, Gray Herb.).

A well-marked species perhaps most closely allied to *B. Rekoi* Standley of Oaxaca. From that species it differs in having glabrous obtuse leaves, elongate corolla with exserted tube, and also a smaller calyx with shorter teeth, glabrous outer surface, and practically non-stipitate base.

Bourreria panamensis, nom. nov.

Bourreria superba, var. *glabra* Schery, Ann. Mo. Bot. Gard. 29: 366 (1942).

A plant known only from a suite of collections made near Chiriqui Lagoon, prov. Bocas del Toro, in northwestern Panama, *Wedel* nos. *2472*, type, *2949* and *2974*. It shows many similarities with *B. superba* Johnston of western Mexico (Guerrero and Michoacan), but since it differs consistently in many details and comes from a region not only with a different climate but also geographically far removed from that of its relative, it seems best to give it specific recognition. Among the characters distinguishing *B. panamensis* are its glabrous twigs, its glabrous more elongate leaves, its glandular rather than hairy filaments, its shorter and broader anthers, and its shorter and stouter corolla-tube. Its calyx is not densely strigose inside but is glabrous except for some minute hairs on the lobe-margins. Its style is about half as long as that of its relative. As with *B. superba* its fruit remains unknown.

Heliotropium confertifolium Torr. var. **coldenioides**, var. nov.

Differt a varietate typica planta caespitosa vel prostrata; ramulis foliiferis strigosis saepe griseis (pilis contortis ascendentibus haud gestis); foliis et sepalis basim versus sparse strigosis sed margine evidenter ciliatis.

COAHUILA: Zacate near Muzquiz, *Marsh 521;* near La Azufrosa, Sept. 22, 1848, *Gregg 509;* base of hills near Saltillo, 1905, *Palmer 523.* NUEVO LEON: 11 mi. south of Sabinas Hidalgo, *Muller 2630;* east of Cerralvo, May 29, 1847, *Gregg;* Marin, Dec. 1852, *Thurber;* Monterrey, June 22, 1848, *Gregg 180;* Monterrey, *Dr. Edwards;* canyon 12 mi. west of Monterrey, *Painter & Barkley 14247;* Montemorelos, *Shreve & Tinkham 9816;* Linares, *Lundell 7284;* Marguerita, south of Monterrey, *Hitchcock & Stanford 6863.* TAMAULIPAS: San Carlos, *Berlandier 3199;* 4 km. west of Miquihuana, *Stanford et al. 744* (TYPE, Gray Herb.). SAN LUIS POTOSI: Rio Verde, stony ridge, 1904, *Palmer 5;* Minas San Rafael, 1911, *Purpus 4862A;* without locality, 1878, *Parry & Palmer 616.*

The present variety is the eastern form of the species and is best developed east of the Sierra Madre Oriental. Ranging south at low altitudes in Tamaulipas and Nuevo Leon it reaches eastern San Luis Potosi, and accordingly much further south than typical *H. confertifolium.* It is a prostrate or distinctly caespitose plant and does not develop the erect or ascending leafy stems of the typical form of the species. Its stems are

strigose and usually sparingly so, and are not clothed with both appressed hairs and abundant short contorted ones as in true *H. confertifolium*. The leaves and sepals are usually very sparingly strigose on the inner face especially below the middle, and their margins, especially towards the base, are evidently ciliate. In the erect-growing typical form of the species the leaves and sepals are densely clothed with appressed hairs and their margins are not noticeably ciliate. In general habit our plant much resembles species of *Coldenia* of the section *Eddya*.

Torrey, Bot. Mex. Boundary 138 (1859), apparently distinguished our plant from what was later called *H. confertifolium*, but mistakenly identified it as "*H. limbatum* Benth." Typical *H. confertifolium* Torr. ex Gray was first described as *H. limbatum* var. *confertifolium* Torr., l. c. It was based upon five collections: Leon Springs, Pecos Co., Texas, *Bigelow;* San Vicente, Coahuila, *Parry;* Cerralvo, Nuevo Leon, *Gregg;* Devils River, Val Verde Co., Texas, *Wright 481;* and hills of the Pecos, Pecos Co., Texas, *Wright 1547*. The Gregg specimens represent the variety *coldenioides*, but the remaining ones are all typical *H. confertifolium*. True *H. confertifolium* is known north of the Mexican boundary only in Texas where it has been found in Brewster, Pecos, Terrell, Val Verde, Maverick, Webb, Zapata, Starr and Hidalgo counties. In Mexico it occurs near the Rio Grande in northern Tamaulipas but extends far south into that country only in the state of Coahuila. One collection is at hand from extreme southeastern Chihuahua. In Coahuila it is scattered in occurrence and at many places seems to favor gypseous soils, especially those associated with beds of Upper Cretaceous age. Forms transitional to the variety *coldenioides* are found in Coahuila only at low altitudes in the eastern parts of the state.

Heliotropium queretaroanum, sp. nov.

Planta 2–4 dm. alta basim versus fruticosa; ramis foliiferis gracilibus sparse ramosis vel simplicibus 0.5–1 mm. crassis sparse strigosis (pilis 0.5–0.8 mm. longis pallidis donatis) internodiis 0.3–2 cm. longis; foliis 1–2 (–2.5) cm. longis 0.5–2.5 mm. latis linearibus vel anguste lanceolatis inconspicue costatis haud nervatis margine planis vel evidenter revolutis apice acutis basi in petiolum ca. 1 mm. longum contractis, facie superiori viridibus inferiori pallidioribus utrinque sparse strigosis; inflorescentia gracili racemosa secunda ebracteata laxiflora 5–10 cm. longa; calyce sub anthesi 2.5–3 mm. longo praesertim basim versus strigoso, lobis subulatis inaequilongis, pedicello 0.5–2 (–3) mm. longo; corolla alba ad 6 mm. longa, tubo extus strigoso, lobos calycis haud superanti, limbo 3–5 mm. diametro, lobis ovatis apice obtusis; nuculis 4, dorse alte convexis plus minusve villulosis; stylo quam stigmate 2–3-plo breviori; stigmate subulato ad 0.8 mm. longo.

QUERÉTARO: Near Higuerillas, Aug. 23, 1905, *Rose, Painter & Rose 9800* (TYPE, U. S. Nat. Herb.); Ciervo, Cerro de la Mesa, Aug. 20, 1905, *Altamirano 1589* (US).

A species very closely related to *H. angustifolium* Torr. and one occurring in a detached area well beyond the southern limits of that species. Its relative is a small bush with stiff woody stems and branches, and has linear leaves 1 mm. wide or less and corollas that have acute lobes. The

flowers are borne in usually abbreviated crowded racemes which at most reach only 5 cm. in length. The proposed species is noticeably different in habit of growth, leaf-width, length of inflorescence, and shape of corolla-lobes. Its slender, weak, elongate, somewhat flexuous stems are ascending and spring from a scanty fruticulose caudex formed of the persisting basal portion of stems of the previous season. The leaves of the Querétaro plant are obviously larger and broader than those of its northern relative. Its inflorescences are conspicuously more elongate and abundantly and loosely flowered, even at anthesis being 5–10 cm. long. Its corolla lobes are somewhat broader and are obtusish rather than acute or subulate.

Heliotropium texanum, sp. nov.

Herba annua erecta 1–3 dm. alta sparsiramosa; caule 1–1.5 mm. crasso sparse antrorseque strigosis (pilis pallidis ad 0.5 mm. longis donatis); ramis ascendentibus simplicibus ad 2 dm. longis; foliis pleraque alternis sed infimis 1–2 oppositis; lamina costata sed enervata viridi strigosa oblanceolata vel lanceolata 1–2 cm. longa 2–7 mm. lata, apice acuta, basi in petiolum 2–5 mm. longum attenuata, margine plus minusve revoluta; inflorescentia secunda multiflora elongata racemosa, fructifera ad 1 dm. longa bracteis foliaceis sparse ornata; calyce sub anthesi ca. 3 mm. longo ad 1 mm. longe pedicellato strigoso, fructifero ca. 5 mm. longo 1–2 mm. longe pedicellato, lobis 0.5–1 mm. latis inaequilongis lanceolatis; corolla alba infundibuliformi 8–10 mm. diametro, tubo ca. 3 mm. longo extus sparse strigoso, faucibus intus villulosis, lobis limbi 5 ovatis 2–3 mm. longis 2–2.5 mm. latis apice rotundis, sinibus latis plicatis fundite quisque lobulo triangulari 0.2–0.5 mm. alto donatis; antheris ca. 0.9 mm. longis apice cohaerentibus acutis hispidulis; filamentis perbrevibus ca. 1.5 mm. supra basim corollae affixis; ovario glabro; stylo 0.8–1 mm. longo; stigmate ca. 0.7–0.9 mm. longo elongato attentuato basi annulato incrassato ad 0.3 mm. diametro; fructu villuloso 1 mm. alto; nuculis 4 homomorphis, dorse alte convexis pilis mollibus erectis non rariter apice uncinatis vestitis, ventre angulatis faciebus fovea circulari conspicua donatis.

TEXAS: South of San Antonio, *Rose & Russell 24144;* 10.5 mi. NW of Falfurrias, Duval Co., 1935, *Cory 14746;* 8.3 mi. NE of Riviera, Kleberg Co., 1935, *Cory 17082;* Kenedy Co., June 26, 1941, *Tharp;* 3 mi. S of Sarita, King Ranch, Kenedy Co., on sandy plain, erect, corolla white with a yellow-orange eye, Oct. 1946, *Lundell 14721* (TYPE, Gray Herb.).

An annual species related to *H. assurgens* Johnston, of western Mexico. It differs in having a slightly coarser, lower, and less branched habit of growth, very much larger corollas, and fewer-flowered inflorescences. At the base of the broad sinus between the corolla-lobes there is usually a triangular lobule, in form generally broader than long, and in most cases proportionately better developed than in the corollas of *H. assurgens.* The plant at first glance bears some resemblance to the Texan *H. convolvulaceum* var. *racemosum* (Rose & Standley) Johnston and has actually been confused with it. The resemblance, however, is purely superficial, since the plants are not even closely related and, furthermore, differ in a host of details in flower and fruit structure.

Heliotropium Wigginsii, sp. nov.

Herba annua 1–4 dm. alta simplex vel sparsissime ascendenteque ramosa; caule 1–1.8 mm. crasso pilis pallidis rigidulis ca. 0.5 mm. longis antrorse adpressis sparse vestito; ramis 0–3, simplicibus 5–20 cm. longis; foliis basim versus caulis oppositis ceteris alternis saepissime 1–3 cm. distantibus; lamina oblanceolata 1–4 cm. longa 2–6 mm. lata supra medium latiori deinde basim versus in petiolum 1–3 mm. longum gradatim attenuata costata sed enervata, margine plana vel plus minusve revoluta, supra viridibus, subtus subpallida, facie utrinque strigosa (pilis pallidis rigidulis ca. 0.5 mm. longis basi pustulatis donata); inflorescentia secunda racemosa maturitate 1–3 dm. longa infra medium bracteis foliaceis 1–2.5 cm. longis ornata, supra medium bracteis inconspicuis subulatis 1–10 mm. longis gesta; calyce ad anthesin ca. 3 mm. longo apicem tubi corollae attingenti, lobis subaequilongis sparse strigosis margine rigido-ciliatis; calyce fructifero 0.7–1.2 mm. longe pedicellato, lobis cuneatis vel lanceo-cuneatis; corolla alba conspicua infundibuliformi extus sparse strigosa intus in faucibus villulosa alibi glabra; limbo 10–15 mm. diametro; lobis oblongis ad 6 mm. longis et 3 mm. latis apice obtusis, sinibus latis profundis plicatis fundite quisque lobulo 1–1.5 mm. longo triangulari apice caudato incurvato donatis; antheris ad 12 mm. longis apice encrassatis truncatis villulosis haud cohaerentibus; filamentis ad 0.2 mm. longis ca. 1.5 mm. supra basim tubi corollae affixis; ovario glaberrimo; nuculis 4 homomorphis glabris ad 2 mm. altis, dorse alte convexis medium versus plus minusve rugosis et tuberculo prominulo donatis, ventre angulatis in utroque facie marginem versus fovea parva elliptica donatis, apice in rostrum erectum compressum breve abrupteque attenuatis.

SONORA: 8 mi. west of Hermosillo on road to Kino Bay, near rain pools in clay on mesquite-covered flat, Aug. 27, 1941, *Wiggins & Rollins 115* (TYPE, Gray Herb.); 19 mi. north of Colorado, between Colorado and Mazatán, gentle gravelly grassy slope, Sept. 7, 1941, *Wiggins & Rollins 355.* BAJA CALIFORNIA: 5 mi. north of Comondu, open plateau thickly strewn with lava rocks, Oct. 3, 1941, *Hammerly 169.*

An erect, sparingly branched annual species with very distinctive corolla and fruit. The attractive white corollas have 5 large oblong lobes separated by broad, deep, plaited sinus. A distinct lobule arises from the bottom of each sinus. This lobule, usually folded, is triangular when spread and is contracted at the tip into a short strap-shaped incurving apical appendage. The spread corolla of the species, accordingly, appears to have a limb made up of alternating large and small lobes. The nutlets are entirely glabrous. Each has a high convex back that is usually somewhat ridged and above the middle is puckered up into a teat- or wart-like protuberance. The nutlet-tip is slightly prolonged, flattened, and upturned. The inner faces of the nutlet each bear a rather small, elliptic, submarginal perforation. The species is very well marked. I can suggest no close relative.

Macromeria guatemalensis, sp. nov.

Planta perennis multicaulis suffruticosa 3–15 dm. alta scabrida; ramis hornotinis viridibus foliatis ad 5 mm. crassis subsimplicibus vel ramulos axillaris ascendentis pluris ad 1 dm. longos gerentibus hispidis et minute adpresseque pubescentibus (pilis majoribus 1–2 mm. longis erectis rigidis

e basi bulbosa orientibus, minoribus 0.2–0.8 mm. longis antrorse adpressis); ramis et ramulis annotinis delapsu foliorum denudatis non rariter decorticatis apice ramulos foliatos novellos ad 2 dm. longos proferentibus; foliis lanceolatis 2.5–5 cm. longis 6–15 mm. latis subsessilibus vel ad 1 mm. longe petiolatis, apice attenuatis, basi rotundis ad acutis, margine anguste revolutis, supra viridibus venis et costa impressis evidenter notatis bases pilorum antrorse adpressorum rigidorum abundantium 0.2–0.8 mm. longiorum silicosas tuberculatas vel subconicas persistentis gerentibus, subtus griseis costa et venis salientibus donatis pilos gracilis adpressos 0.8–1.2 mm. longos pallidos e basibus pustulatis orientis juventate abundantis maturitate sparsiores proferentibus; floribus apicem versus ramuli gestis; calyce ad anthesin 1 cm. longo 3–8 mm. longe pedicellato, lobis inaequalibus linearibus ca. 1 mm. latis prominenter costatis bases pustulatas pilorum gracilium 0.4–0.8 mm. longorum ascendentium abundantis gerentibus; corolla lutescenti ca. 3.5 cm. longa extus hispidula intus glabra, tubo parte basali ca. 10 mm. longa 1–1.2 mm. crasso deinde sursum abrupte expanso, parte superiore cylindrico ca. 17 mm. longo ca. 5 mm. crasso; lobis corollae triangularibus 6–8 mm. longis 5–6 mm. latis summum ad apicem rotundis; filamentis 4–7 mm. longis ca. 3 mm. longe sub altitudinem sinus affixis; antheris 2.5–3 mm. longis elongatis oblongis medio-affixis; stylo filiformi exserto; nuculis albis osseis levibus ovoideis ad 3 mm. longis.

GUATEMALA: Above San Juan Ixcoy, Sierra Cuchumatanes, dept. Huehuetenango, 2400 m., high bluff in upper reaches of barranco, subligneous and bushy, 1–3 ft. tall, corolla pale yellow, "te de monte," infusion of leaves used for colds, *Steyermark 50069;* dry upper southfacing slope of Volcan Tajumulco, between Las Canojas and top of ridge, 7 mi. from San Sebastian, dept. San Marcos, erect herb 4–5 ft. tall, fl. with yellow tube and green lobes, lvs. stiff, dull green above, gray beneath, "etama real," fruit used for "los cuentas," *Steyermark 35898* (TYPE, Gray Herb.).

A new species of a genus heretofore unknown from south of Mexico. It is related to *M. Pringlei* Greenm. of southern Mexico (Hidalgo, Guerrero and Oaxaca). Unlike its relative it has strong stems that become somewhat woody and function for at least two seasons. The hairs on the plant have excessively developed siliceous bases. They almost pave the upper leaf-surfaces and make the stems verrucose. The calyx-lobes are prominently ribbed and are rough with numerous hair bases. The corolla averages distinctly smaller than in *M. Pringlei.*

Dasynotus, gen. nov. Boraginaceae-Boraginoidearum.

Calyx 5-partitus longe pedicellatus segmentis elongatis in statu fructifero fere duplo accrescentibus donatus. Corolla hypocraterimorpha conspicua glabra; lobi 5 elliptico-oblongi imbricati patentes; tubus cylindricus calyce brevior, intus fere ad basim appendiculas 10 minima tumescentes gerens; fauces inconspicuae angustae abrupte expansae. Fornices corollae fundus faucium orientes magni exserti ligulati supra medium extrorse recurvati apice pendenti conspicue breviterque bilobati, medium versus puberulenti, apicem versus minute papillati, infra medium margine minute ciliolati. Stamina 5 inclusa fere ad apicem tubi corollae affixa; filamenta brevia compressa attentuata; antherae anguste oblongae obtusae paulo infra medium affixae. Ovarii lobi 4 distincti in gynobasi pyramidali oblique affixi. Stylus filiformi-subulatus apice gynobasis inter apices nuculearum gestus a nuculis liber; stigma simplex disciformum minimum. Gynobasis maturi-

tate cartilaginea late pyramidalis magna excavationibus conspicuis ovatis apice attenuatis crasse marginatis ornata. Nuculae 4 conformes late ascendentes ovatae dorsi-ventraliter compressae laeves pro tribo Eritrichiae magnae, facie dorsali pilis albis simplicibus erectis gracilibus abundantibus obsitae margine erecto vel ascendenti angusto humuli inermi cinctae, facie ventrali glabrae cicatrice majusculo convexo prominulo medio vel paulo supra medium donatae in tertiam partem superiorum prominenter carinatae alibi valde convexae. Semina recta supra medium lateraliter affixa, cotyledones planae indivisae, radicula superior. — Herba perennis multicaulis erecta semi-metralis viridis. Folia alterna oblanceolata. Cincinni terminales pauci laxi sparsiflori solum basim versus paucibracteati. Pedicelli elongati maturitate saepe deflexi tendem basi ima disarticulati. — Nomen derivatur a δασυς (hispidum) et νῶτον (dorsum), quia nuculae dorse hispidulosae sunt.

Dasynotus Daubenmirei, sp. nov.

Herbae radice perenni valida oriens; caulibus numerosis fistulosis erectis ad 5 dm. altis simplicibus foliosis 2–5 mm. crassis sparse hispidulosis (pilis 0.5–2 mm. longos gerentibus); foliis caulinis infimis reductis, ceteris 1–2 cm. distantibus oblanceolatis evidenter costatis 9–13 cm. longis 1.5–3 cm. latis supra medium latioribus deinde basim sessilem 2–4 mm. latum versus attenuatis, ubique pilos 0.5–1.5 mm. longos antrorse appressos vel ascendentes non rariter e basi plus minusve pustulato haud conspicuo erumpentes vix abundantes gerentibus, subtus pallidioribus nervos primarios utroque laterae costae 5 gestos haud ramosos graciles inconspicuos proferentibus; inflorescentia apice caulis gesta racemosa laxissima basim versus folios parvos 1–2 ad 6 cm. longos et 1.5 cm. latos proferenti alibi ebracteata, rhachi in statu fructifero ad 10 cm. longa flores 0–3.5 cm. distantes gerenti; pedicellis sub anthesi 1–2.5 (–3) cm. longis erectis mox divaricatis vel decurvatis, maturitate divergentibus vel basi deflexis et tandem ibique disarticulatis; calyce plus minusve strigoso, lobis cuneatis vel cuneato-lanceolatis acutis sub anthesi 6–8 mm. longis 1–1.5 mm. latis erectis, fructiferis ad 14 mm. longis et infra medium ad 3 mm. latis evidenter costatis ascendentibus; corolla alba ad 22 mm. diametro, tubo 4.5–5 mm. longo 4–4.5 mm. diametro, lobis 6.5–8 mm. latis 8–9 mm. longis apice rotundis; fornicibus ad 4 mm. longis supra medium ad 0.8 mm. latis deinde deorsum basim 1.5–1.7 mm. latum versus latioribus, apice pendenti bilobulata 0.5 mm. profunde emarginatis; filamentis ad 1 mm. longis ca. 1 mm. infra apicem tubi corolla affixis, antheris 1.5–2 mm. longis; stylo 3–5 mm. longo; nuculis saepissime 4 ascendentibus 5–6 mm. longis 4–4.5 mm. latis 2–2.5 mm. crassis in ambitu late ovatis, facie exteriori dense hispidulosis (pilos 0.5–0.9 mm. longos uniloculares gerentibus) maturitate interdum subglabrescentibus margine rugae angustae 0.2–1 mm. altae erectae glabrae circumdatis, facie interiori sublucentibus cicatrice centrali vel supra centrali 1–1.2 mm. longa ad 1 mm. lata donatis; gynobasi fructiferi 2 mm. alta basi ima 3–4 mm. diametro deinde sursum abrupte contracto pyramidali, faciebus pyramidis sub angulo 40° inclinatis excavationes basi 1–1.5 mm. latos supra medium abrupte contractos gerentibus.

IDAHO (Idaho Co.): Moist roadside in draw, vicinity of Walde Mt. L. O., open place in spruce-fir zone, June 24, 1945, *R. F. Daubenmire 4535;* near Walde Mt. L. O., July 14, 1945, *R. F. Daubenmire 45131;* near Walde Mt. L. O., clearing in forest, July 24, 1946, *R. F. Daubenmire 46289* (TYPE, Gray Herb.).

The discovery of a plant representative of a new genus is always of interest. The recent discovery in the mountains of Idaho of this new monotype is not merely interesting but also a surprise. Among North American Boraginaceae well-marked new species continue to turn up from time to time, but with the sole exception of *Mimophytum* (a Mexican monotype discovered in 1905) all the hitherto recognized American genera have had representatives known to science for at least a century. The prospects have been that the only additional genera recognized would result from the segregation of old concepts or from the possible discovery of a new species set off from some old genus by one or more striking characters that might possibly justify the erection of a new genus. The discovery in Idaho of a new borage which is not merely a very well marked species obviously derived from some recognized genus, but rather a wholly new generic type of very uncertain relationships, is accordingly unexpected. The plant is so distinct, in fact, that, had it been presented to me devoid of geographical data, I would have failed to recognize it as American; I would probably have guessed that it was another one of those very distinct new genera that are from time to time detected in southeastern Asia. As a matter of fact, however, it is no more closely related to the Asiatic Boraginaceae than to the American ones.

In the system of genera the new genus seems best placed near *Hackelia* and *Eritrichium,* preferably just before the former. The plant in gross habit rather suggests *Hackelia* but is very different in inflorescence, nutlets, and faucal appendages. Only in a few details of nutlet structure does it much suggest *Eritrichium.*

The inflorescence of *Dasynotus* is a very loose racemose cyme of slenderly long-pedicellate flowers. In general appearance it is somewhat reminiscent of that of *Borago officinale* L., and so very different from the slender, elongate, secund, racemose flower-clusters of *Hackelia.* The pedicels may become very elongate and are spreading, decurved, or basally abruptly deflexed. At extreme maturity they disarticulate at the very base.

The faucal appendages are certainly unusual and apparently unique in the family. They are about 4 mm. long, ligulate, swollen, and above the middle gracefully and outwardly decurved with the pendent end distinctly cleft. The margin below the middle is ciliolate. The surface of the middle section is pubescent. On the arched outer portion of the appendage the minute pubescence becomes reduced and towards the distal end represented only by very minute papillae. Faucal appendages in some borage genera curve inward and partially close the throat of the corolla. The appendages of *Dasynotus,* however, are not only strongly decurved but they arch outward over the base of the corolla-lobe.

Seated on the cartilaginous pyramidal gynobase the nutlets of *Dasynotus* ascend at a wider angle and protrude more basally than is customary in members of the tribe *Eritrichieae.* In these details the plant simulates members of the *Cynoglosseae.* The nutlets of *Dasynotus,* however, are free from the style, devoid of appendages, and have a central (not apical)

attachment scar, all important details that clearly ally it with the *Eritrichieae*.

The individual nutlets are thickish but distinctly dorsi-ventrally compressed. They are broadly ovate in outline and are 5–6 mm. long and so large for one of the *Eritrichieae*. Ventrally they have a slightly protrudent, convex, ovate, central or somewhat supra-central attachment scar, and above the latter a prominent short ventral keel. The keel, formed of unbroken pericarp and bearing no groove nor thickened tissue, is distinctly elevated above the level of the scar. Except for the keel on its upper third most of the ventrum is convex. It is rather smooth, somewhat lustrous, and light in color. In general plan the ventrum of these nutlets is reminiscent of that in the nutlets of *Plagiobothrys* Sect. *Euplagiobothrys*. I doubt, however, if this resemblance can have any phylogenetic significance.

The dorsal surface of the nutlets of *Dasynotus* is nearly flat or slopes very gently on either side of the medial line. It bears an abundance of slender, white, single-celled hairs that are at first straight and vertical but later may become bent and disarranged. These hairs are neither hooked nor barbed. There may be a very slight swelling on the pericarpial surface where each is attached. When they fall away, as may happen on very old nutlets, the surface of the ventrum may accordingly be very obscurely and minutely tuberculate. Surrounding the hairy ventrum, like a tiny wall about a miniature grainfield, is a narrow glabrous elevated flange that rises vertically all around the margin. This erect flange is a tight projecting fold or wrinkle of pericarpial tissue. It is not differentiated in texture, color, nor surface from tissue adjoining, and has an even height and bears absolutely no appendages, teeth, or any sort of roughenings. It is accordingly very different from the marginal ridge in the nutlets of *Hackelia* and *Lappula*. Among the Boraginaceae nutlets with a dorsum simulating that in *Dasynotus* are to be found only in certain species of *Eritrichium*. In most species of the latter genus the nutlets have a toothed margin, but in some, e. g., *E. elongatum* (Rydb.) Wight of the northern Rocky Mts., the margin is unarmed, even, and seemingly only a protruding wrinkle in the pericarp, much as that found in the nutlets of *Dasynotus*. Also interesting is the fact that some Asiatic species of *Eritrichium* also bear numerous erect straight hairs on the margined dorsum of their nutlets. As a general rule most species of *Eritrichium* have a smooth lustrous pericarp rather similar to that found in *Dasynotus*. The similarities mentioned possibly may be indicative of some relationship between the two genera, though certainly it cannot be a very close one. *Dasynotus* and *Eritrichium* differ in habit of growth, inflorescence, and flower structure, as well as in form, scar, and ventral keeling of nutlets.

The region in Idaho where *Dasynotus* grows is one that exploration during the past decade has shown to be not only rich in local endemics but also notable for outlying inland congregations of species formerly thought to be confined to the coastal mountains of Oregon and Washington. Dr.

Daubenmire's discovery there of *Mertensia bella* Piper, formerly thought to be confined to the Siskiyou region of adjacent Oregon and California, is an example of this.

The particular place where the new genus was discovered lies 65–70 miles ESE from Lewiston in the watershed of the Lochsa River and about 5–10 miles northerly from the town of Lowell at the junction of the Lochsa and Selway rivers. It is in Idaho County near the northern boundary of Nez Perce National Forest and in the vicinity of Walde Mt. Lookout. On July 24, 1946, Professor Daubenmire made the following notes to accompany his no. *48289*, the type collection: "A few plants observed in near-climax arborvitae forest 7.6 mi. east of Waldo Lookout on road towards Frenchman Butte. Plants growing in dense shade send up only a few stems from the crown. Those growing along trails and on cleared areas are much more robust. Eighty-nine stems were counted on one individual, these making a cluster about 25 cm. in diameter at the soil surface. The color of the corollas is pure white." Judging from the collections available the plant appears to flower in June and fruit in July.

Hackelia longituba, sp. nov.

Herba perennis 5–10 dm. alta pilis gracillimis mollibus brevibus adpressis incano-pubescens; foliis inferioribus oblanceolatis ad 15 cm. longis 10–18 mm. latis, infra medium in petiolum 2–3 mm. latum gradatim attenuatis, apice acutis, facie superiori medio costatis sed enervatis, facie inferiori pallidioribus obscure nervatis; foliis caulinis superioribus lanceolatis sessilibus numerosis saepissime 2–3 cm. distantibus ascendentibus majoribus supra basim 8–12 mm. latis, basi rotundis vel subcordatis, apice acutis; inflorescentia sub anthesi densiflora subcylindrica 3–4 cm. crassa 3–9 cm. longa, fructiferi laxa ramulis 6–15 cm. longis ascendentibus laxe 3–10-floris gesta; pedicellis ad anthesin 3–5 mm. longis, fructiferis ad 12 mm. longis; lobis calycis pilis adpressis mollibus incano-pubescentibus, sub anthesi 2–3 mm. longis 0.5–1.2 mm. latis oblongis vel cuneato-oblongis erectis, fructiferis reflexis triangularibus ad 2 mm. latis; corolla infundibuliformi caerulea, limbo 10–15 mm. diametro, tubo cylindrico conspicuo 2–3 mm. crasso 5–7 mm. longo quam lobis calycis duplo longiori, lobis ascendentibus late obovatis 5–7 mm. latis, appendiculis faucium erectis ad 2 mm. altis apice revolutis et conspicue transverseque dialatis pubescentibus subprotrudentibus; filamentis medio tubi affixis 0.2–0.5 mm. longis; nuculis 4 ovatis (sine aculeis ad 5 mm. longis) margine dorseque aculeos 2–2.5 mm. longos apice glochidiatos saepissime distinctos armatis, cicatrice ovata.

CALIFORNIA: Leland Meadow, Tuolumne Co., 1940, *Quick 5;* Fahey Meadow, Tuolumne Co., 1935, *Quick 1449;* 3 mi. NE of Grohl, Tuolumne Co., 1935, *Roseberry 262;* Big Tree Grove, Calaveras Co., 1884, *Ball;* Big Tree Grove, *Mann;* near Big Trees, 1940, *Eastwood & Howell 8593* (TYPE, Gray Herb.); Camp Echo, El Dorado Co., 1915, *Heller 12185;* Fallen Leaf Lake, Tahoe Region, 1906, *Eastwood 1047;* Lake Valley, Tahoe Region, 1911, *Abrams 4766;* Sunnyside, Tahoe Region, 1909, *Eastwood 34;* Cisco, Placer Co., *Rixford.*

A well-marked species which has passed as "*H. velutina* (Piper) Johnston." The type of that latter species, however, came from General Grant Park in Fresno County, and represents the plant with short-tubed subrotate corollas which ranges along the Sierra Nevada of California from

Yosemite Park south to Tulare County. Our present plant occurs in the Sierra Nevada only north of true *H. velutina* and is readily distinguished from that species by its very elongate corolla tube and narrower faucal appendages. An illustration of it, incorrectly identified, is given by Jepson, Fl. Calif. 3: 309, *f. 413* (1943).

Hackelia stricta, sp. nov.

Herba biennis 5–10 dm. alta erecta; caulibus saepe solitariis 3–6 mm. crassis fistulosis infra medium pilos sparsos rigidulos minutos recurvos supra medium ascendentis gerentibus; foliis inferioribus oblanceolatis 5–10 cm. (petiolo incluso) longis 12–30 mm. latis apice acutis infra medium in petiolum 1–5 cm. longum gradatim attenuatis; foliis medialibus et superioribus sessilibus 2–5 cm. longis 1–2 cm. latis medium versus latioribus utroque acutis; lamina folii in facie superiori inconspicue sparseque strigosa (pilis e basi pustulata perinconspicua saepe orientibus), in facie inferiori pallidiori pilis rigidulis minutis erectis vel ascendentibus e pustula inconspicua orientibus donata; inflorescentia elongata, ramis strictis fructiferis 5–10 cm. longis; pedicellis 1–2 mm. longis, fructiferis ad 4 mm. longis strigosis; calyce 1.5–2 mm. longo, lobis oblongo-lanceolatis saepe fuscis; corolla 2–2.5 mm. longa, limbo 4–5 mm. diametro, lobis orbicularibus 1.2–1.7 mm. diametro azureis divaricatis, tubo 1.5 mm. longo ad 1 mm. crasso, appendiculis faucium trapaeziformis minutis; nuculis 4 heteromorphis ca. 3 mm. longis, 1–2 stramineis dorse aculeos congestos 3.5–4 mm. longos apice glochidiatos conspicue gerentibus, 2–3 griseis margine encrassatis dorse aculeis ad 0.5 mm. longis vel papillis apice glochidiatis sparse donatis.

MEXICO STATE: Nevada de Toluca, Oct. 1903, *Rose & Painter 7932* (TYPE, Gray Herb.); Las Cruces, Dist. Temascaltepec, fir forest, *Hinton 4901;* Meson Viejo, Dist. Temascaltepec, by river, *Hinton 1303;* Desierta Vieja, Valley of Mexico, *Bourgeau 881;* Sierra de las Cruces, *Pringle 5259* and *9318;* summit of Ajusco, *Harshberger 130;* Cañada de San Rafael, *Lyonnet 340.* MICHOACAN: Tancitaro, near stream, *Leavenworth 731.* GUERRERO: Teotepec, pine forest, *Hinton 14435.* OAXACA: Sierra San Felipe, *Pringle 4832* and *Nelson 1045.* INDEFINITE: *Coulter 1056.*

This is the widely distributed and repeatedly collected *Hackelia* of central Mexico, usually identified as *H. mexicana* (C. & S.) Johnston. That species, however, is actually known only from the mountains between Jalapa and Orizaba and is most closely related to *H. guatemalensis* Brand, of Chiapas and Guatemala. The present plant is distinguished by its erect stiff habit, biennial root, light green herbage, smaller narrower nutlets with more crowded aculeae, and small faucal appendages. The veins on the under surface of its larger leaves are not densely grayish strigose and so not so conspicuous as those in *H. mexicana* and *H. guatemalensis*. In gross habit our plant most resembles *H. floribunda* (Lehm.) Johnston, of western United States. Its close relationships, however, are with the congeners of Central and South America and particularly with *H. leonotis* of the mountains of Nuevo Leon.

Hackelia Skutchii, sp. nov.

Herba perennis 1–5 dm. alta; caulibus erectis 1.5–3 mm. crassis griseis retrorse strigosis; foliis (radicalibus ignotis) supra viridibus plus minusve antrorse strigosis medio-longitudinaliter sulcatis, subtus pallidis dense retrorse strigosis saepe plus minusve sericeis costa prominenti et non rariter

venis salientibus donatis; foliis inferioribus oblanceolatis 6–9 cm. (petiolo incluso) longis apice acutis et non rariter inconspicueque breviterque acuminatis ca. 2 cm. infra apicem 6–10 mm. latis deinde deorsum in petiolum 1–4 cm. longum 1–2 mm. latum gradatim attenuatis; foliis superioribus lanceolatis sessilibus 1–6 cm. longis basi rotundis; inflorescentia sparse ramosa, ramis fructiferis ad 2 dm. longis; pedicellis 2–4 mm. longis strigosis gracilibus, fructiferis 6–10 mm. longis recurvis; calyce strigoso, lobis ovatis 1 mm. longis fructiferis 1.5 mm. longis; corolla conspicua azurea 7–10 mm. diametro, lobis obovatis divaricatis, tubo ca. 2 mm. longo, appendiculis faucium gibbosis subquadratis minute pubescentibus albis vel flavis salientibus; nuculis 4 heteromorphis 2–2.4 mm. longis ca. 1.5 mm. latis, 3–2 brunneis muricatis dorse papillas sparsas 0.5–1 mm. altas apice glochidiatas gerentibus, 1–2 griseis muricatis aculeos coerulescentis 1–1.5 mm. longos compressos apice glochidiatos dorsaliter et marginaliter sparse proferentibus.

GUATEMALA: Sierra Cuchumatanes, Huehuetenango, alpine meadow, 10,500 ft., fl. palest blue, yellow at center, Aug. 24, 1934, *Skutch 1103* (TYPE, Gray Herb.); near Tunimá, Sierra Cuchumatanes, 3300–3500 m., leaves gray green, corolla pale blue with creamy white raised crown around center, *Steyermark 49257;* above San Juan Ixcoy along trail to Tojquiá, Sierra Cuchumatanes, 2800–3400 m., corolla pale blue with orange center, *Steyermark 50113.*

A very distinct species characterized by its large pale blue subrotate corollas with salient white, orange or yellow faucal appendages, its heteromorphic nutlets, and its relatively small leaves usually silky strigose beneath. The nutlets not only bear barbed papillae or spines but also numerous conic roughenings on back and sides. At times these pointed roughenings are even terminated in a short bristle. The plant is very well marked and has no obviously close relatives. Its general relationships, however, are with the congeners of Central America and southern Mexico.

Hackelia leonotis, sp. nov.

Herba biennis 3–5 dm. alta; caulibus 2–6 mm. crassis pilis gracilibus 1–2 mm. longis plus minusve retrorsicurvatis laxis vestitis; foliis supra strigosis subtus pilis gracilibus non rariter plus minusve retrorsis laxe vestitis, inferioribus oblanceolatis 5–15 cm. (petiolo incluso) longis lamina 10–18 mm. lata utroque acuta basi in petiolum 3–6 mm. longum 1–2 mm. latum attenuata donatis, superioribus anguste lanceolatis sessilibus 3–6 cm. longis 5–10 mm. latis apice acutis basi angulato-rotundis; ramis inflorescentiae sparsis strictis, fructiferis 10–15 cm. longis; pedicellis 2–4 mm. longis dense strigosis fructiferis 4–6 (vel rariter ad 9) mm. longis; calyce strigoso, lobis sub anthesi ovatis vel triangulari-ovatis obtusis 1–1.5 mm. longis, fructiferis ovato-deltoideis vel late ovatis ad 3 mm. longis; corolla caerulea, limbo 2.5–4 mm. diametro, lobis ovatis divaricatis, tubo ad 1 mm. longo, appendiculis faucium trapaeziformis minutis pallidis; nuculis 4 heteromorphis ca. 3 mm. longis, 2–3 griseis tuberculas vel aculeos perbrevis apice glochidiatos sparse armatis, 1–2 dorse et marginem versus aculeos 1.5–3 mm. longos gracilis apice glochidiatos gerentibus.

NUEVO LEON: Peak of Cerro Potosi, scattered in upper pine wood, *Mueller 2255* (TYPE, Gray Herb.); near peak of Cerro Potosi, abundant in moist meadow in pine forest, 11,900 ft. alt., 1938, *Univ. Illinois Exped. 969;* Cerro Potosi, 1938, *Schneider 969;* ascent of Cerro Potosi, north hogback about 20 mi. NE of Galeana, common in top pine forest, alt. 11,300 ft., *Mueller 1250;* Canyon below Las Canoas, on Cerro Potosi among shrubs in moist arroyo, *Mueller 2228.*

A well-marked species known only from the peak of Cerro Potosi in the Sierra Madre Oriental of northeastern Mexico. Its relationships are with the species of central and southern Mexico and not with those of United States. In fruiting structures it is very similar to *H. Skutchii* of Guatemala, but very different otherwise, and especially in corolla and in foliage-indument. The plant of Cerro Potosi is especially notable for its erect simple or strictly and sparingly branched stems, its very loose somewhat shaggy indument on stems and lower leaf-surfaces, its evidently heteromorphic nutlets, and its very small corollas.

Cryptantha abata, nom. nov.

Krynitzkia depressa Jones, Contr. W. Bot. 13: 5 (1910), not *Cryptantha depressa* Nels. (1902).

Oreocarya depressa (Jones) Macbride, Contr. Gray Herb. 48: 32 (1916).

Cryptantha modesta Payson, Ann. Mo. Bot. Gard. 14: 278 (1927), not Brand (1924).

The name Payson applied to this well-marked species of southern Utah is invalid because of an earlier homonym, a fact overlooked until it was recently called to my attention by Mr. William A. Dayton.

Cryptantha Barnebyi, sp. nov.

Planta perennis 1.5–3 dm. alta pilis flavescentibus vestita; foliis caudicis oblanceolatis 5–8 cm. (petiolo incluso) longis costatis sed enervatis, 1–2 cm. infra apicem acutum vel anguste obtusum 7–14 mm. latis deinde deorsum in petiolum 1.5–2.5 mm. latum plus minusve 3–4 cm. longum gradatim attenuatis, pilis rigidis rectis numerosis 1.5–2 mm. longis valde appressis e basi pustulata orientibus et pilulis inconspicuis mollibus 0.1–0.5 mm. longis dense vestitis; foliis inferioribus caulinis oblanceolatis ad 5 cm. longis 5–8 mm. latis hirsutis (pilis rigidis ascendentibus e basi pustulata orientibus donatis); caulibus horni rigidis erectis costatis ad 5 mm. crassis hirsutis (pilis rigidis pungentibus divaricatis 1.5–3 mm. longis et pilulis abundantioribus plus minusve retrorsis perinconspicuis 0.1–0.5 mm. longis vestitis) e caudice denso ramulos crassos congestos brevis basibus foliorum annotinis crasse vestitos composito erumpentibus; inflorescentia maturitate ad 15 cm. longa, apice densissima ca. 4 cm. crassa deinde deorsum angustiore et cymas gradatim minoris gerenti, infra medium bracteis conspicuis foliaceis linearibus 15–30 mm. longis et 2–4 mm. latis donata; calyce fructifero ad 13 mm. longo 1–2 mm. longe pedicellato, lobis lanceo-subulatis infra medium ad 2 mm. latis extus setis divaricatis 1.5–3.5 mm. longis et pilulis inconspicuis abundantibus 0.5–1 mm. longis gestis; corolla glabra ad 14 mm. longa, tubo cylindrico 7 mm. longo 2–3 mm. crasso, faucibus 3.3–4 mm. longis sursum ampliatis apice ca. 4 mm. diametro, lobis rotundis 2–2.5 mm. longis 2.5–3 mm. latis, appendiculis faucium intrusis bigibbosis 0.7 mm. latis 0.5 mm. altis pilulis perbrevibus obesis obsitis; antheris 1.5 mm. longis, filamentis perbrevibus 1 mm. infra appendiculas faucium affixis; nuculis 4 griseis nitidis utrinque levibus 4 mm. longis 2.5 mm. latis, margine acutissimis, dorse convexis in ambitu ovatis, ventre late obtusis, sulco angusto lineari fere ad apicem nuculae attingenti.

UTAH: 30 miles southeast of Ouray, Uintah Co., white shale knolls 5550 ft. alt., growing with *C. Grahamii* but much less common, June 17, 1947, *Ripley & Barneby 8748* (TYPE, Gray Herb.); 5 mi. west of Bitter Creek on Watson-Ouray road, knoll among junipers on light-colored shale, 6300 ft. alt., fl. pale yellow, May 26, 1935, *Graham 8987*.

A well-marked species and like *C. Grahamii* and *C. Rollinsii* apparently confined to the Green River Shales in the Uintah Basin of northeastern Utah. Among the distinctive features of the present plant are its yellowish indument, coarse dense caudex, large, long-tubed, protruding corollas, and lustrous, completely smooth, sharp-margined nutlets. The flower color appears to be either white or slightly yellow. One of the cited collections, *Graham 8987,* is immature and was previously listed, Jour. Arnold Arb. 20: 391 (1939) as representative of *C. Rollinsii* Johnston. It is now recognized as belonging to the species so beautifully represented by Mr. Barenby's ample flowering and fruiting material from southeast of Ouray. *Cryptantha Rollinsii* is a biennial plant with grayish or only slightly yellowish indument. Its basal leaves are neither so large nor so narrowly petiolate as those in the sterile leaf-clusters borne on the dense stout caudex of *C. Barnebyi.* Its nutlets are also very different. They are proportionately more elongate in outline, rarely surpass 2 mm. in width, and are always more or less roughened with broad low ridges and tuberculations, especially towards the apex and margins. The decidedly smooth nutlets of *C. Barnebyi* are more suggestive of *C. confertiflora* (Greene) Payson. They have, however, a more prolonged ventral groove and are merely sharp- and not wing-margined. The immediate relations of *C. Barnebyi* are with none of the species mentioned. As a matter of fact I can suggest no species with which it reveals close relationship. It is a very distinct species and one I find pleasure in associating with the name of Mr. Rupert C. Barneby. His very many discriminatingly selected and beautifully prepared specimens are evidence of his interest in this group of West American plants.

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A NOTE ON PHILIP MILLER'S BINOMIALS

E. D. MERRILL

MILLER'S *Gardeners Dictionary*, which between the years 1731 and 1807 passed through nine editions in England, and was also translated into French and into German, is a work well known to both botanists and to horticulturists. The taxonomists particularly became concerned with it chiefly when the eighth edition appeared in 1768, for in this edition Miller abandoned the cumbersome pre-Linnaean system of indicating the names of plants by Latin descriptive phrases and accepted the simple binomial system. In the preface to edition eight, p. [3], he states:

"In the last edition of this work [edition 7, 1759, and the Dublin issue of it in 1764], the author adopted in great measure the system of Linnaeus . . . but as many of the plants . . . were not to be found in any of Linnaeus's works then published, Tournefort's system was also applied to take such as were not fully known to Dr. Linnaeus."

While in edition seven he did give numerous references to various Linnaean publications, including even the Species Plantarum, he did not then accept the binomial system and continued to utilize the pre-Linnaean descriptive sentences for individual species. Thus the entry "18. Physalis (*Peruviana*)" of edition eight appears in edition seven as "18. Physalis *caule erecto ramoso, ramis angulatis, foliis sinuatis, calycibus acutangulis.*" This is merely a simple illustrative case among about 5000 entries. Miller's work is not a simple one to cite for the reason that the 1348 folio pages of edition eight are not numbered, so that generally entries to his new binomials are indicated as *Guilandina glabra* Mill. Gard. Dict. ed. 8, no. 3. 1768; the genera which he recognized are alphabetically arranged.

Thus accurate citation becomes somewhat complicated if one should wish to indicate the exact place of publication of an unlisted binomial such as *Adenanthera pavonica* Mill. In the *Adenanthera* entry in volume one, p. [26], a single species is recognized, and it is there characterized merely as *Adenanthera foliis decompositis*. The very last page of volume two is devoted to a long list of corrections including some additions of binomials where, in the text, apparently by oversight, the pre-Linnaean descriptive phrases had been used. *Adenanthera pavonica* Mill. is actually listed on page [1348] of the entire work as some librarian has worked out the pagination for the Arnold Arboretum copy of this edition.

In an addendum to my paper on the validity of Bartram's[1] binomials I called attention to the fact that if the new names appearing in Bartram's *Travels* (1791) be eliminated, as Dr. Rickett[2] claimed they should be,

[1] **Merrill, E. D.** On the Validity of William Bartram's Binomials. Bartonia **23**: 35. 1945.

[2] **Rickett, W. H.** Legitimacy of Names in Bartram's 'Travels.' Rhodora **46**: 289–391. 1944.

then it could be legitimately argued that all of the new names published by Miller in the eighth edition of his *Gardeners Dictionary* (1768) could also be ignored. This would be catastrophic, because Miller used approximately 5000 binomials, and some hundreds of them were proposed by him as new. Dr. Rickett's argument was that as Bartram did not consistently use the binomial system, accordingly his work should be eliminated under the provisions of Article 68 of the International Rules. My study showed that Bartram *intended* to follow the binomial system, for he used about 360 different binomials, his own new ones and those proposed by earlier botanists, notably Linnaeus and Walter; in only two cases did he use the pre-Linnaean descriptive sentences in lieu of binomials, and in these two cases it was apparently by oversight that he did not indicate specific names in the form of binomials.

An examination of Miller's work, which has been universally accepted by all botanists as a source of new binomials, shows that he too, like Bartram, was inconsistent, and that the percentage of cases where he used only descriptive sentences is probably higher than it is in the Bartram case. Yet it is highly improbable that any botanist would argue for the elimination of Miller's work merely because he was somewhat inconsistent; and this in spite of the fact that a critical study of his early proposed species, the actual types of most of which are extant in the Sloane herbarium at the British Museum, will result in a considerable number of nomenclatural upsets.

I noted that in the entries under the letter A alone there are about eighteen cases where Miller used descriptive sentences with no indication of a binomial, many of these in genera where he otherwise used binomials. These are: *Adenanthera foliis decompositis; Alchemilla foliis lobatis sericeis . . . ; Aloe foliis erectis subulatis . . . ; Althaea foliis simplicibus acuminatis . . . ; Amomum scapo nudo spica ovata; Amomum scapo nudo spica oblonga obtusa; Amomum scapo bracteis alternis laxis . . . ; Anguria foliis multipartisis; Aparine semine laevi; Aparine semine coriandri saccharati; Aparine pumila supina, flore caeruleo; Arbutus caulibus procumbentibus, foliis integerrimis; Arctotis foliis pinnato-laciniatis . . . ; Asparagus caule herbaceo erecto . . . ; Atraphaxis ramis spinosis; Atriplex caule erecto herbaceo . . . ; Atriplex caule fruticoso foliis deltoideis . . . ;* and *Atriplex caule fruticoso foliis obovatis.* There are scattered additional entries of this nature up to and including some under the letter M; there are few or none in the remainder of the work.

Miller himself noted his lack of consistency, for the last page of the second volume of the *Dictionary* is devoted to corrections, and here there are about 220 binomials, including many of those which he should have entered instead of the descriptive sentences when he described certain species. These entries appear as: "Adenanthera, add (*Pavonica*)," "Alchimella 2. add (*Hybrida*)," "Aloe, 10. Add (*Humilis*)," "Asparagus 1. add (*Sativa*)," "Atriplex 1. (add *Hortensis*)," etc.

One suspects that it was his intention to provide specific names to replace all of the descriptive sentences which he used in the text, but he overlooked a certain number of these. Thus for the three species of *Aparine* no binomials are suggested, for the *Althaea,* and the *Arctotis,* a single species in each genus, and for the *Arbutus* no binomials are suggested, while in *Gramen,* which he used as a generic name, he described seven species with descriptive sentences, yet in his corrections he added specific names for only three of these. The last polynomial that I have noted is *Mammea staminibus flore brevioribus.* From this one suspects that Miller realized that he was inconsistent in the first volume of his work, but that he gave more critical attention to binomials in the second volume. Clearly it was his intention to use the binomial system consistently, even if he failed to do so in some cases.

A great many of the new Miller binomials were checked on Index Kewensis, and the coverage is excellent. In fact, whoever checked this work actually detected and listed most of the new names which appear not only in the text proper but on the last page of volume two, where Miller manifestly attempted to unify his use of technical names. This is unusually good indexing, for in no case, either in the text or on this last page, is there any indication that this or that binomial is actually a new one.

The only reason that I have prepared this short note is because I had previously called attention to Miller's violation of Article 68 of the International Rules which provides, *inter alia,* that specific epithets are illegitimate: "When they were published in works in which the binary nomenclature for species was not consistently employed." In my personal opinion this should not be applied to either Bartram's *Travels* or to the eighth edition of Miller's *Gardeners Dictionary.* Manifestly both authors intended to follow the binary system, even if they did in a relatively very few cases fail to do so.

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AMBORELLA TRICHOPODA BAILL., A NEW MORPHOLOGICAL TYPE OF VESSELLESS DICOTYLEDON

I. W. Bailey and B. G. L. Swamy

With five plates

INTRODUCTION

The genus *Amborella* is represented by a single species, *A. trichopoda* Baill., which is endemic to New Caledonia. This remarkable plant was provisionally named and briefly described in a footnote by Baillon (5) in 1869, and was more extensively discussed by him (6) in 1873. Baillon's descriptions were based upon material collected by Vieillard (nos. *32* and *2296*) and Balansa (no. *1800*) in moist forests in the environs of Balade. The plant is stated to be a shrub of slightly scandent habit which attains a height of from six to eight meters. The best illustrations of its leaf, its male inflorescence, its male flowers, and its fruit are those of Perkins (13); the female flowers are unknown. The only anatomical investigations of the plant are those of Perkins (12), who closely followed Hobein's (8) procedure in the study of monimiaceous genera and focused her attention primarily upon the structure of the leaf and upon the width of the rays in the secondary tissues of the stem. In so doing, she appears to have overlooked the extremely significant fact that the xylem of *Amborella* is vesselless and resembles that which occurs in young stems of *Drimys* and of other representatives of the Winteraceae.

Baillon stressed the close similarity of the male flower to that of *Hedycarya* and included *Amborella* in the Monimiaceae. Subsequently, Bentham and Hooker (7) placed the genus in the tribe Monimieae of the Monimiaceae, whereas Pax (11), and Perkins and Gilg (14) included it in the tribe Hortonieae of the sub-family Monimioideae of this family.

The fact that a new type of living vesselless dicotyledon should come to light at this late date has many important morphological implications; the eight previously known genera of vesselless dicotyledons were all well known prior to 1900, van Tieghem (16). It seemed advisable, accordingly, to make as comprehensive a morphological study of *Amborella* as possible, the results of which are summarized on succeeding pages.

MATERIAL EXAMINED

The absence of vessels in the xylem of *Amborella trichopoda* Baill. was first detected in a specimen collected by Vieillard (no. *3149*), on loan to the Arnold Arboretum from the Gray Herbarium. This observation sub-

sequently was verified by examination of the stems of a series of other specimens. A complete list of the material studied is as follows:

Gray Herbarium

Vieillard 3149, specimen with *female flowers* and fruits.
Balansa 1800, specimen in fruit.

Arnold Arboretum

Vieillard 3149, specimen with immature male flowers.

Museum of Natural History, Paris

(Specimens loaned through the courtesy of Professor H. Humbert, Director).
Vieillard 3149, specimen in fruit.
Vieillard 32, specimen with male flower buds.
Balansa 1800, specimen in fruit.
Pancher, Sept. 1870, specimen in fruit.
Licard, 1879, specimen in fruit.

Herbarium of Royal Botanic Gardens, Kew

Vieillard 3149, two male flowers at anthesis, sent through the kindness of Sir Edward Salisbury, Director.

The *Vieillard 3149* sheet of the Gray Herbarium bears numerous fruits, and, in addition, a few female flowers which unfortunately have been fed upon at some time by insects. However, we have succeeded in reconstructing the form of the previously unknown female flower by a careful study of these fragments.

THE STEM

The largest stem of *Amborella* (*Vieillard 3149,* G.H.) of which we have succeeded in obtaining material is seven millimeters in diameter. A transverse section of a smaller stem, 3.5 millimeters in diameter, is illustrated in *Fig. 30.* The phloem and the collenchymatous outer cortex are considerably compressed owing to contraction in drying, *Figs. 30, 31,* and *37,* but the pith, the primary and the secondary xylem, and the zone of cortical sclerenchyma are well preserved. The pith is relatively homogeneous, being composed of moderately thick-walled, conspicuously pitted parenchyma, and being devoid of idioblasts, nests of stone cells, or sclerenchymatous diaphragms. Vertically elongated strands of parenchyma are confined to the perimedullary region in close proximity to the elements of the primary xylem.

Most of the rays of the secondary xylem are uniseriate or biseriate, as emphasized by Perkins (12). However, broader rays, three to five cells in width, are of not infrequent occurrence, and extend outward from conspicuous interfascicular parts of the eustele, *Fig. 37.* The narrower rays are vertically extensive and are composed of much elongated "erect" cells, *Fig. 38.* The cells of the multiseriate rays tend to become nearly as ex-extensive radially as vertically. Wood parenchyma strands are few in number and are diffusely distributed.

The tracheids of the vesselless xylem occur in relatively uniform radial seriations, *Fig. 37.* They are long imperforate tracheary cells, *Fig. 38,* and, in the case of the secondary xylem, obviously are formed, as in *Tetra-*

centron, Trochodendron, and the Winteraceae, by a primitive type of cambium having long fusiform initials with extensively overlapping ends. The inter-tracheary pitting, which is dominantly scalariform in the last-formed tracheids of the metaxylem, fluctuates between scalariform and circular in the secondary xylem, *Fig. 39.* The conspicuously bordered pits are numerous and tend to be more or less closely crowded in the radial walls of the tracheids, whereas they are smaller and of sporadic occurrence in the tangential walls. The pits between tracheids and parenchymatous cells are small, circular, and bordered.

There are no fibers in the phloem or the cortex of the stem. The sclerenchymatous ring visible in *Fig. 30* is composed solely of "hippocrepiform" sclereids, *Fig. 31.* The parenchymatous cells of the phloem and the outer cortex contain much darkly colored, colloidal, vacuolar material of presumably phenolic composition, *Fig. 31.*

THE LEAF

The alternately disposed leaves of *Amborella* fluctuate considerably in size, form, and degree of pilosity even on sheets having the same collection number. Some are oblong with slightly wavy margins, as figured by Perkins (13), whereas others are ovate with conspicuous lobes, *Figs. 1* and *3,* or are elliptic-lanceolate with entire or serrate margins, *Fig. 2.* Certain of the leaves, viz. *Vieillard 32* (Paris), *Balansa 1800* (Paris), *Licard,* 1879 (Paris), have numerous hairs on both surfaces, whereas others, i.e. *Vieillard 3149* (G.H.), are glabrous. Whether such differences are due solely to differences in age of the leaves, as has been assumed, appears to us to be somewhat questionable.

The leaf is characterized by having a single broad, arc-shaped strand of vascular tissues in its petiole, *Fig. 32,* and in the costa of the lamina, *Fig. 33.* This leaf trace is attached to the eustele of the stem at a typical unilacunar node, *Fig. 30.* Thus, *Amborella* differs from *Tetracentron* and the Winteraceae, which have prevailingly trilacunar nodes, and from *Trochodendron,* which tends to form multilacunar ones.

The cortical parenchyma of the petiole is collenchymatous, collapses in drying, and does not fully re-expand even when treated with sodium hydroxide, *Fig. 32.* Hippocrepiform sclereids either are absent or develop less precociously in the petiole and the basal part of the costa, compare *Figs. 30, 32,* and *33.* On the contrary, the upper part of the mid-vein, the lateral veins, and the terminal veinlets are completely jacketed by hippocrepiform sclereids. According to Perkins (12), there are no palisade or hypodermal tissues in the lamina of the leaf. However, when leaves are cleared and re-expanded by treatment with sodium hydroxide, there appears to be a well defined hypodermal layer subtending the upper epidermis. The cells of the spongy mesophyll, *Fig. 33,* as in the case of the phloem and the outer cortex of the stem, contain a high ratio of darkly colored vacuolar material, i.e. "Gerbstoffe," Perkins (12).

The stomata are confined to the lower surface of the leaf. They fluctu-

ate considerably in form and the extent to which the guard cells are subtended by parts of adjacent epidermal cells. The stomata may have subsidiary cells that are oriented parallel to the guard cells, *Fig. 6*, or they may be surrounded by a number of ordinary epidermal cells, *Fig. 5*. The stomata are provided with a conspicuous outer cuticular vestibule as illustrated in *Fig. 7*.

The foliar hairs are straight and comparatively short, but are of a thin-walled multicellular type, *Fig. 4*. These trichomes are jacketed by a thick cuticle which is continuous with that of the outer surface of the leaf. The hair may have a single submerged basal cell or it may be attached to a more or less protuberant, multicellular pedestal.

THE MALE FLOWER

The male flowers of *Amborella* have been described by a succession of authors, viz. Baillon (6), Bentham and Hooker (7), Pax (11), Perkins and Gilg (14), and have been figured by Perkins (13). Although the concensus of opinion appears to be that the stamens are numerous ("ultra 20"), Perkins and Gilg (14) in their key to the genera of the Monimiaceae differentiate *Amborella* from *Peumus* upon the basis of "Stamina 9 eglandulosa, Fl. ♀ sine staminodiis," whereas in their description of *Amborella* they state, in agreement with other writers, "Stamina ∞ (ultra 20) . . . Fl. ♀ ignoti." Subsequently Perkins (13) figured a male flower from *Vieillard 3149* (Kew) with 19 stamens. In material examined by us, *Vieillard 3149* (Kew) and *Vieillard 32* (Paris), the number of stamens varied from 10 to 12.

The stamens are stated to have "filamentis brevissimis" and are figured by Perkins (13) with narrow, short, cylindrical "filaments." In the material of *Vieillard 3149* (Kew), the stamens at anthesis, *Figs. 8* and *9*, as in so many other ranalian plants, are broad, flat appendages bearing sporangia. The outer stamens tend to be larger and exhibit a more conspicuous branching of the vascular strand, compare *Figs. 8* and *9*. The basal parts of the stamens bear more or less numerous, faintly striated hairs. These hairs commonly are unicellular, but may at times be composed of two cells. The epidermal cells at the apex of the outer stamens tend to differentiate into numerous papillae.

The male flower appears to have incipient perigynous tendencies, i.e. concavity of the torus and concrescence and adnation of parts. However, the vascularization of the flower is still relatively simple. The pedicel contains a ring of discrete vascular bundles and each bracteole is vascularized by a single strand. The vascular bundles increase in number toward the base of the torus and each tepal is vascularized by a single strand. The inner stamens exhibit no evidence of adnation to the base of the tepals and each is vascularized by a single trace from the apex of the torus. On the contrary, the larger outer stamens are vascularized by branches from the trace of the tepal which subtends them.

The pollen grains of *Amborella* resemble those of various monimiaceous genera in having a tenuous, finely papillate exine. They fluctuate considerably in form. Those obtained from open flowers of *Vieillard 3149* (Kew) have an irregular unthickened area on one polar face, *Figs. 18* and *19*, whereas pollen from flower buds of *Vieillard 32* (Paris) are uniformly thickened and granular appearing on all surfaces. The former pollen grains are circular in polar view, *Figs. 18* and *19*, having a diameter which averages approximately 27 micra. When viewed at right angles to the presumed polar axis, the pollen grains exhibit the form illustrated in *Fig. 20*, i.e. broader and flatter on the face opposite the germinal area. This shape of the pollen suggests that the grains may possibly be formed in tetragonal tetrads, and the irregular unthickened area may be on the proximal side of the grain as in certain of the Annonaceae, Bailey and Nast (1).

THE FEMALE FLOWER

The gross external morphology of the female flower, reconstructed from fragments of open flowers of *Vieillard 3149* (G.H.), may be summarized as follows:

Pedicel naked or bearing from one to four bracteoles. Tepals six to eight, slightly connate at the base, in two series, those of the inner more nearly cyclic series broader with expanded membranous margins. Staminode one, or occasionally two, resembling the stamens of the male flower in form, but sterile and basally adnate to a subtending tepal. Carpels five, free, obovoid, borne on the slightly convex center of the torus; stigma oblique, sessile, extensive, with two conspicuous feathery flanges.

In general, the pedicel and the perianth of the female flowers, *Figs. 12* and *13*, resemble those of the male flowers. Although there is no sharply defined differentiation into calyx and corolla, the five upper tepals commonly are larger, broader, and have a more nearly cyclic orientation. The staminode, *Figs. 10, 13*, and *14*, is broad and basally adnate to a subtending tepal, *Fig. 14*. It commonly bears a more or less rudimentary anther, with sporangial cavities and more or less extensive endothecial thickening, but is devoid of pollen in the limited number of specimens that we have examined.

The carpel of *Amborella* appears to exhibit a particular trend of specialization of the primitively conduplicate ranalian carpel, compare Bailey and Nast (2). The basal part of the carpel is sealed, whereas the extensively developed paired stigmatic crests of the upper part of the conduplicate carpel are unfolded, *Figs. 15* and *16*. Each carpel contains a single anatropous ovule which is directly attached to the ventral side of the locule by a short, obliquely oriented raphe. The level of attachment to the carpellary wall fluctuates between one-half and two-thirds of the distance between the base and the apex of the locule. The micropylar end of the ovule points downward at an angle of considerably less than 90 degrees to the axis of the raphe. The ovule is krassinucellate and bitegumentary,

Fig. 11. The inner integument consists uniformly of three layers of cells, whereas the outer one is composed of five to seven layers on the rapheal side.

The primary vascular system of the pedicel of the female flower is typically eustelic, consisting of a ring of discrete bundles, *Fig. 22*, as in the pedicel of the male flower. Each scale-like bracteole is vascularized by a single strand, *Figs. 22* and *23*. Just below the level of the perianth, the bundles of the eustele become more diffusely arranged owing to incipient broadening of the torus. The traces of the tepals are clearly differentiated at the level illustrated in *Fig. 24*. Each tepal has a single trace in its connate base, which subsequently divides into a median and two lateral veins in its lamina. At the levels illustrated in *Figs. 25* and *26*, there are two concentric circles of vascular strands, an outer one concerned with the tepals and staminode and an inner one of five bundles concerned with the vascularization of the five carpels. At the base of each carpel, its vascular bundle bifurcates into a large dorsal strand and a smaller ventral one, *Fig. 27*. The dorsal strand develops extensive branches and terminates in an inverted spray of vascular elements, *Figs. 15* and *16*. The ventral strand bifurcates in its upward course and the vascular supply of the ovule is derived from one of its branches. The concrescence of tepals is clearly indicated in *Figs. 26* and *27*. The adnation of the staminode to its subtending tepal is still evident at the levels illustrated in *Figs. 28* and *29*.

THE FRUIT

The drupaceous fruit is obovoid with slightly compressed sides and apex. Vestiges of the stigmatic crests occupy a subterminal position, *Fig. 17*, due to asymmetrical development of the carpel after fertilization. In the case of dried specimens, the external surface of the fruit appears to be reticulately wrinkled with evenly distributed depressed areas, as illustrated by Perkins (13). However, when the fruit is re-expanded, these depressions disappear and the entire surface of the fruit becomes smooth. The stony endocarp is not a sclerenchymatous tissue of uniform thickness as figured by Perkins (13), but has highly embossed ridges on its outer surface, corresponding with a complex, reticulate system of vascularization of the exocarp. The softer parts of the exocarp, between the embossed ridges of the thick sclerenchymatous layer, appear at times to give rise to cup-shaped lysigenous lacunae, *Fig. 34*. The unaffected outer layer of the exocarp presents a more or less uniform cellular organization, though the general uniformity may be defaced here and there by the eruption of corky excrescences.

A single seed occupies the entire cavity of the fruit, *Fig. 34*. Baillon (6) and Willis (17) state that the seed is pendulous and orthotropous, but the orthotropy has been questioned by Pax (11). As we have demonstrated on preceding pages, the ovule is anatropous, *Fig. 11*. During post-fertilization development, the enlargement of the carpel and seed is such that the lateral attachment of the seed appears to occur at a higher

level in the locule. At the same time, the originally oblique raphe becomes deflected, as indicated by its vascular strand, into an orientation more nearly at right angles to the long axis of the seed, *Fig. 17*. In fruits from herbarium specimens, the crushed remains of the two integuments have assumed a membranous texture and constitute the seed coat, *Fig. 35*. The cells of the outermost layer of the outer integument are conspicuous owing to their content of darkly colored, phenolic, vacuolar material.

The bulk of the seed, *Fig. 35*, is composed of a compact endosperm whose constituent cells are of relatively uniform size and shape, those at the periphery, however, being smaller and having more darkly stained contents, *Fig. 36*. The embryo is minute, *Figs. 35* and *36*, and is situated at the lower apex of the downwardly projecting seed. In fruits from various collections examined by us, the embryo exhibits merely incipient stages of the formation of cotyledonary primordia.

SECRETORY IDIOBLASTS AND CRYSTALS

According to Perkins (12), there are no secretory cells containing ethereal oils or resins in the pith or cortex of the stem, but she states that a few small cells of this type occur in the spongy mesophyll of the leaf. Although we have utilized a variety of special techniques, we have not succeeded in demonstrating the presence of such cells in any tissues of the stem, leaf or floral appendages. Nor have we succeeded in demonstrating the presence of mucilaginous cells, such as occur in the Lauraceae and are considered to differentiate this family from the related Monimiaceae.

The tissues of *Amborella* do not contain druses or large rhombic crystals of calcium oxalate. Nor have we been able to find small acicular crystals which are stated by Solereder (15) to occur so commonly in the Monimiaceae, Lauraceae, and Hernandiaceae. However, entire absence of crystals and of secretory idioblasts cannot be conclusively established until properly preserved material of freshly collected specimens is obtainable.

DISCUSSION

Since the publication of Baillon's (6) description, *Amborella* has consistently been placed in the Monimiaceae, and by Pax (11) and Perkins and Gilg (14) in the Hortonieae, the florally most primitive tribe of the family. The vesselless xylem of *Amborella* raises the question whether the genus actually belongs in the Monimiaceae, and what its relationships to other vesselless genera of the dicotyledons may be.

Relatively few botanists are inclined to follow van Tieghem (16) in segregating vesselless dicotyledons in a special order, the Homoxylées. Indeed, there are grave dangers in basing phylogenetic conclusions and classification upon the study of any *single* organ, tissue, or morphological character. Much of the confusion in past and present botanical literature is due to a failure to recognize that parallel and convergent evolution are of common occurrence in all organs of the vascular plants, and to allow for the fact that morphological specializations rarely, if ever, occur simultane-

ously and at uniform rates in all parts of a plant. Deductions regarding relationships should be based, therefore, upon careful assessment of evidence from all organs, tissues, and parts of the plant.

The totality of morphological evidence indicates that the Winteraceae (*Drimys, Pseudowintera, Bubbia, Belliolum, Exospermum,* and *Zygogynum*) are at best only remotely related to the Magnoliaceae and other surviving ranalian families, Bailey and Nast (3). Similarly, it demonstrates that, although *Tetracentron* and *Trochodendron* should be placed in close proximity, they bear no close relationship to the Winteraceae or even to such genera as *Euptelea* and *Cercidiphyllum,* Bailey and Nast (4), Nast and Bailey (9 and 10).

The general structural similarity between the vesselless xylem of *Amborella* and that of comparable young stems of the Winteraceae, *taken by itself,* provides no cogent evidence for including the genus in that family. Fundamental structural differences in the flowers, in the pollen, in the pith and cortex, and in the vascularization of the leaf, etc., provide a negation of such a possibility. In even greater measure, the totality of evidence excludes any possibility of including *Amborella* either in the Tetracentraceae or the Trochodendraceae. This leaves unanswered the question whether *Amborella* should likewise be excluded from the Monimiaceae.

Possible evidences of relationship to the Monimiaceae are (1) incipient perigynous tendencies particularly in the male flower, coupled with unisexuality, (2) form and structure of the pollen, (3) uniovulate carpels, (4) presence of hippocrepiform sclereids, (5) unilacunar nodal anatomy, (6) absence of druses and large rhombic crystals of calcium oxalate, and (7) absence of a combination of special morphological characters indicative of close relationship to any other family. Potentially significant differences are (1) absence of vessels and of septate fibers in the xylem, (2) absence of fibrous sclerenchyma in the pith and cortex of the stem, and in the leaf and other appendages, (3) apparent absence of conspicuous secretory idioblasts containing ethereal oils or resinous contents, and (4) the presence of multicellular hairs; according to Solereder (15) the Monimiaceae are characterized by having unicellular trichomes or variously clustered groups of such hairs.

Whether *Amborella* should be retained within the Monimiaceae or should be segregated in a new related family must await the results of extensive coöperative investigations that we have undertaken of the various genera of the Monimiaceae. Sufficient progress has already been made, however, to demonstrate that if the present narrow concept of the family is to be retained, other genera in addition to *Amborella* should be excluded from the Monimiaceae (sensu stricto). For example, *Trimenia* and *Piptocalyx* have a fundamentally different type of nodal anatomy, have no hippocrepiform sclereids in the cortex of young stems, and have large mucilaginous cells which have been used as a reliable criterion for differentiating the Monimiaceae (absent) from the Lauraceae (present). On the contrary, if the existing concept of the Monimiaceae is to be broadened to in-

clude such genera as *Amborella, Trimenia,* and *Piptocalyx,* it should likewise include such genera as *Gomortega* and *Austrobaileya.*

It should be noted in conclusion that the nine surviving genera of vesselless dicotyledons exhibit a wide range of diversified specializations in their floral organs, indicative, as prophesied by van Tieghem (16), that additional morphological types will ultimately be discovered either in living or fossil floras. Of the nine known genera, five (*Bubbia, Belliolum, Exospermum, Zygogynum,* and *Amborella*) occur in New Caledonia, and three (*Amborella, Exospermum,* and *Zygogynum*) are endemic on that Island.

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EXPLANATION OF PLATES

All plates show *Amborella trichopoda* Baill.

PLATE I

Figs. 1–3. *Balansa 1800* (Paris). Variation in the form of the leaves. × ½. **Fig. 4.** *The same.* Multicellular hair. × 280. **Fig. 5.** *Vieillard 3149* (G.H.). Surface view of a stoma showing subsidiary epidermal cells. × 600. **Fig. 6.** *The same.* Stoma with subsidiary cells oriented parallel to the guard cells. × 600. **Fig. 7.** *The same.* Transverse section of a stoma, showing the cuticular vestibule. × 600. **Figs. 8** and **9.** *Vieillard 3149* (Kew). An outer and an inner stamen viewed from their adaxial side. × 21. **Fig. 10.** *Vieillard 3149* (G.H.). Staminode of a female flower, showing sterile anther. × 21. **Fig. 11.** *The same.* Longitudinal section of a carpel, showing pattern of vascularization and the anatropous ovule. × 25.

PLATE II

Fig. 12. *Vieillard 3149* (G.H.). Reconstruction of a female flower, with one inner tepal removed to show the five carpels. Staminode at the right. × 10. **Fig. 13.** *The same.* Flower oriented to show the breadth of the staminode. × 10. **Fig. 14.** *The same.* Part of a female flower, showing one carpel and the adnation of the basal part of the staminode to its subtending tepal. × 10. **Fig. 15.** *The same.* Lateral view of a cleared carpel, showing pattern of vascularization. × 33. **Fig. 16.** *The same.* Cleared carpel, viewed from its dorsal side. × 33. **Fig. 17.** *The same.* Longitudinally dissected, cleared fruit, showing vascularization and attachment of the seed. × 8. **Figs. 18** and **19.** *Vieillard 3149* (Kew). Polar views of pollen, showing variation in the size and form of the irregular unthickened areas. × 800. **Fig. 20.** *The same.* Pollen grain viewed at right angles to the polar axis. × 800.

PLATE III

Figs. 22–29. *Vieillard 3149* (G.H.). Diagrammatic transverse sections of a female flower cut at successive levels, as shown in **Fig. 21.** S, vascular strand of staminode. × 33.

PLATE IV

Fig. 30. *Vieillard 3149* (G.H.). Transverse section of the stem, showing unilacunar node and vesselless xylem. × 16. **Fig. 31.** *The same.* Hippocrepiform sclereids more highly magnified. × 170. **Fig. 32.** *Balansa 1800* (Paris). Transverse section of the petiole, showing single arc of vascular tissues. × 33. **Fig. 33.** *The same.* Transverse section of the midvein of the lamina. × 33. **Fig. 34.** *Vieillard 3149* (G.H.). Longitudinal section of the fruit, showing outwardly projecting sclerenchymatous ridges, and lacunae in the outer exocarp. × 9. **Fig. 35.** *Licard* (Paris). Longitudinal section of a seed, showing extensive endosperm and minute embryo. × 16. **Fig. 36.** *Pancher* (Paris). Micropylar region of a seed, showing contracted embryo. × 170.

PLATE V

Fig. 37. *Vieillard 3149* (G.H.). Transverse section of the stem, showing vesselless xylem, uniseriate, biseriate, and multiseriate rays, and hippocrepiform sclereids of the cortex. × 73. **Fig. 38.** *The same.* Tangential longitudinal section of the secondary xylem, showing form of the rays. × 73. **Fig. 39.** *The same.* Radial longitudinal section of the secondary xylem, showing the pitting of the tracheids. × 340.

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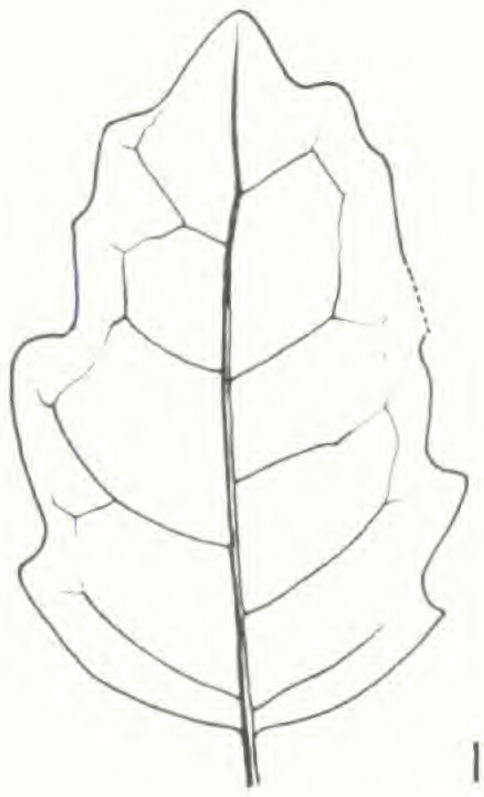

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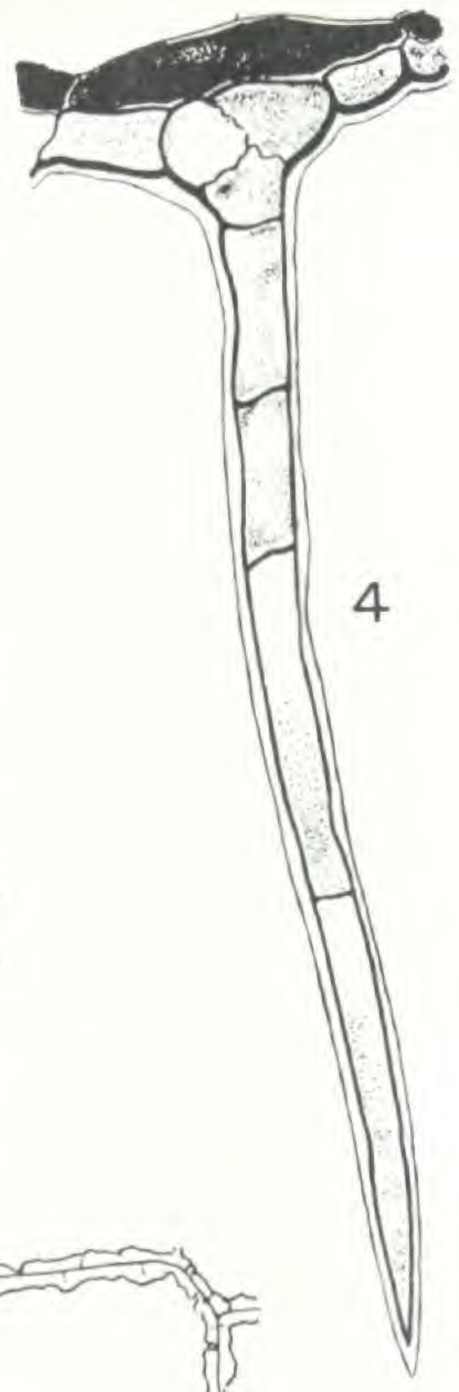

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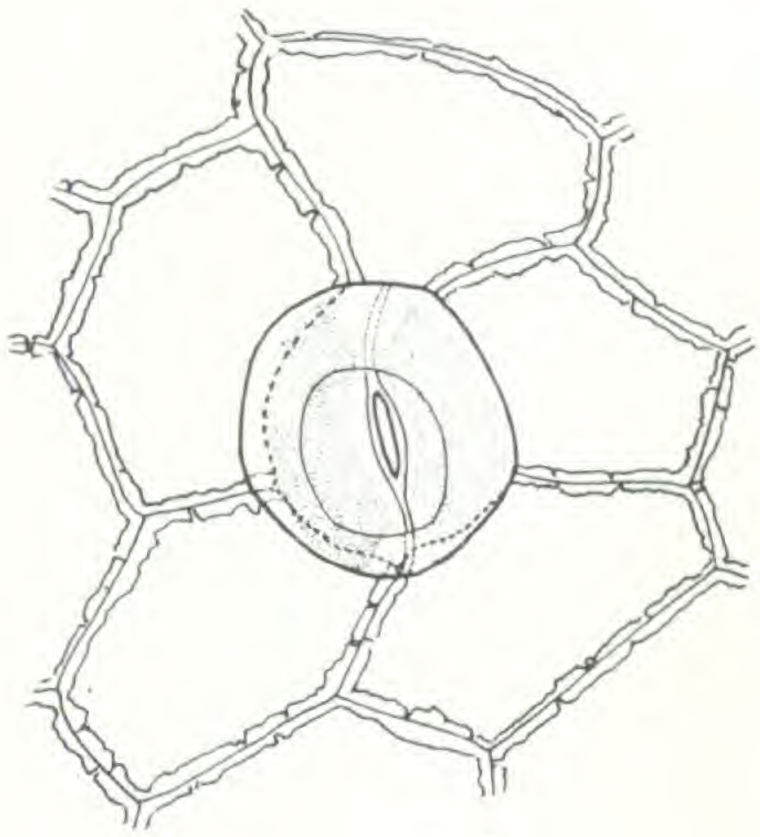

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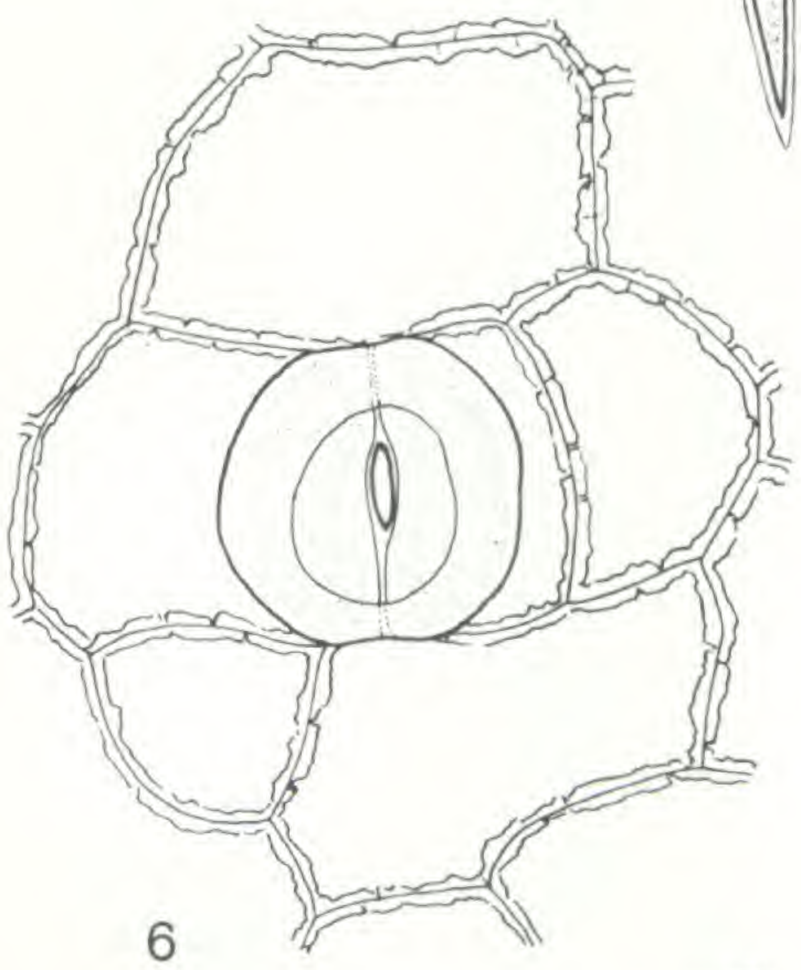

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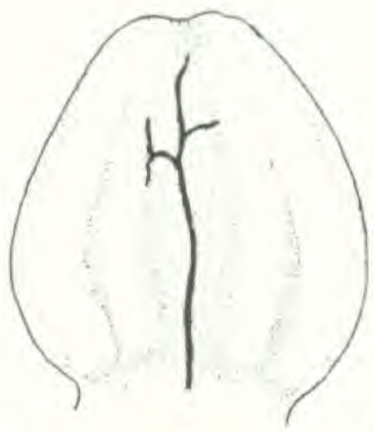

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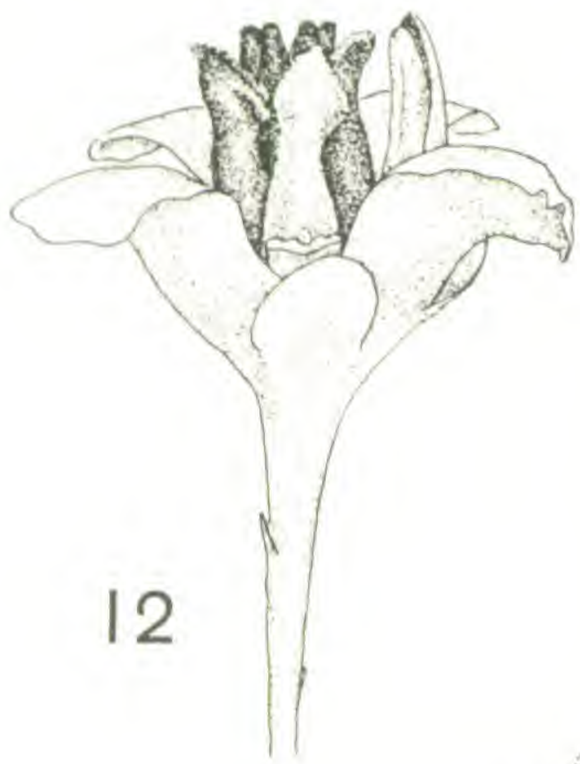

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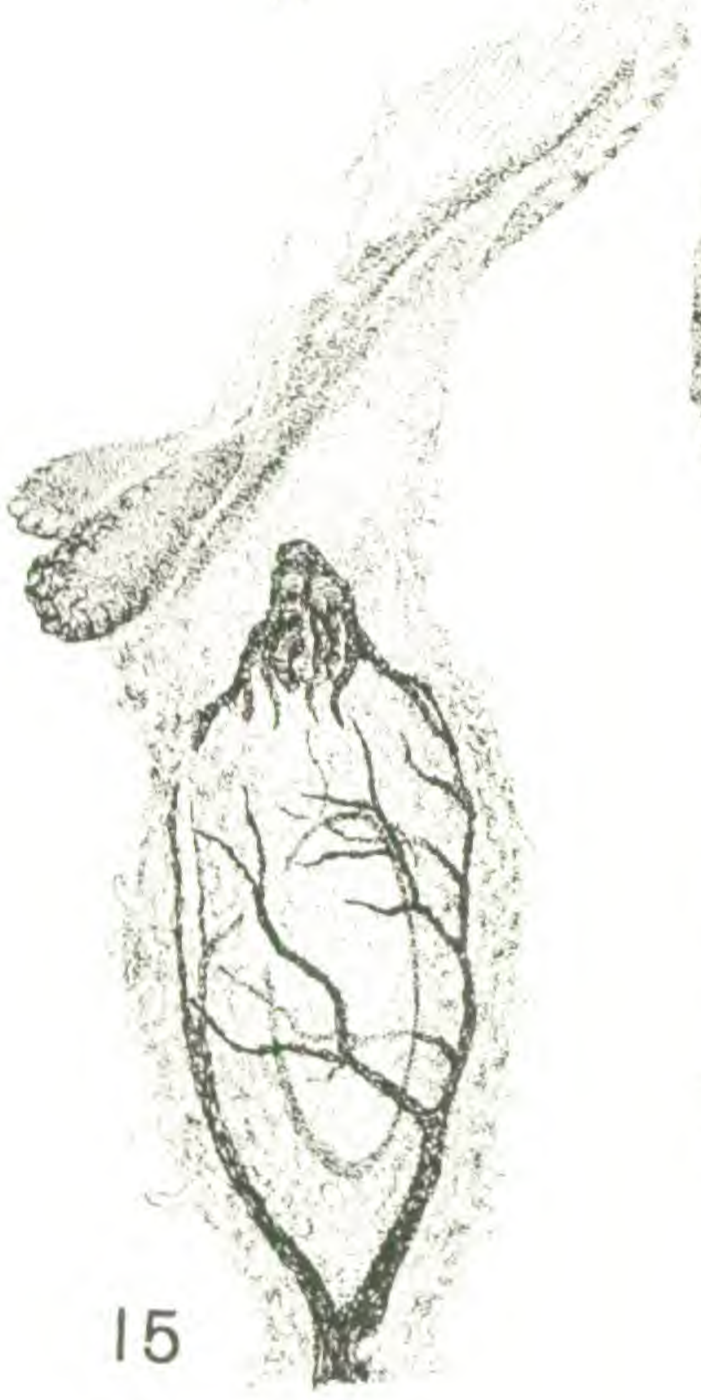

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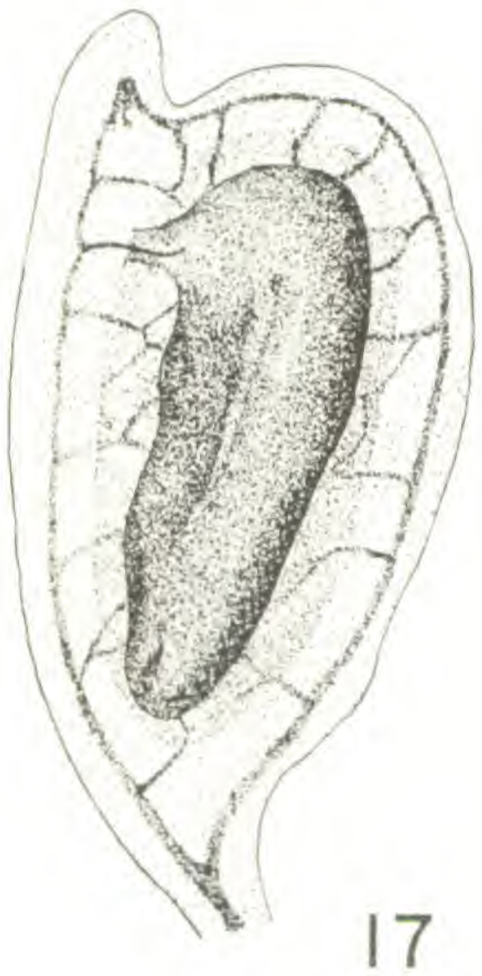

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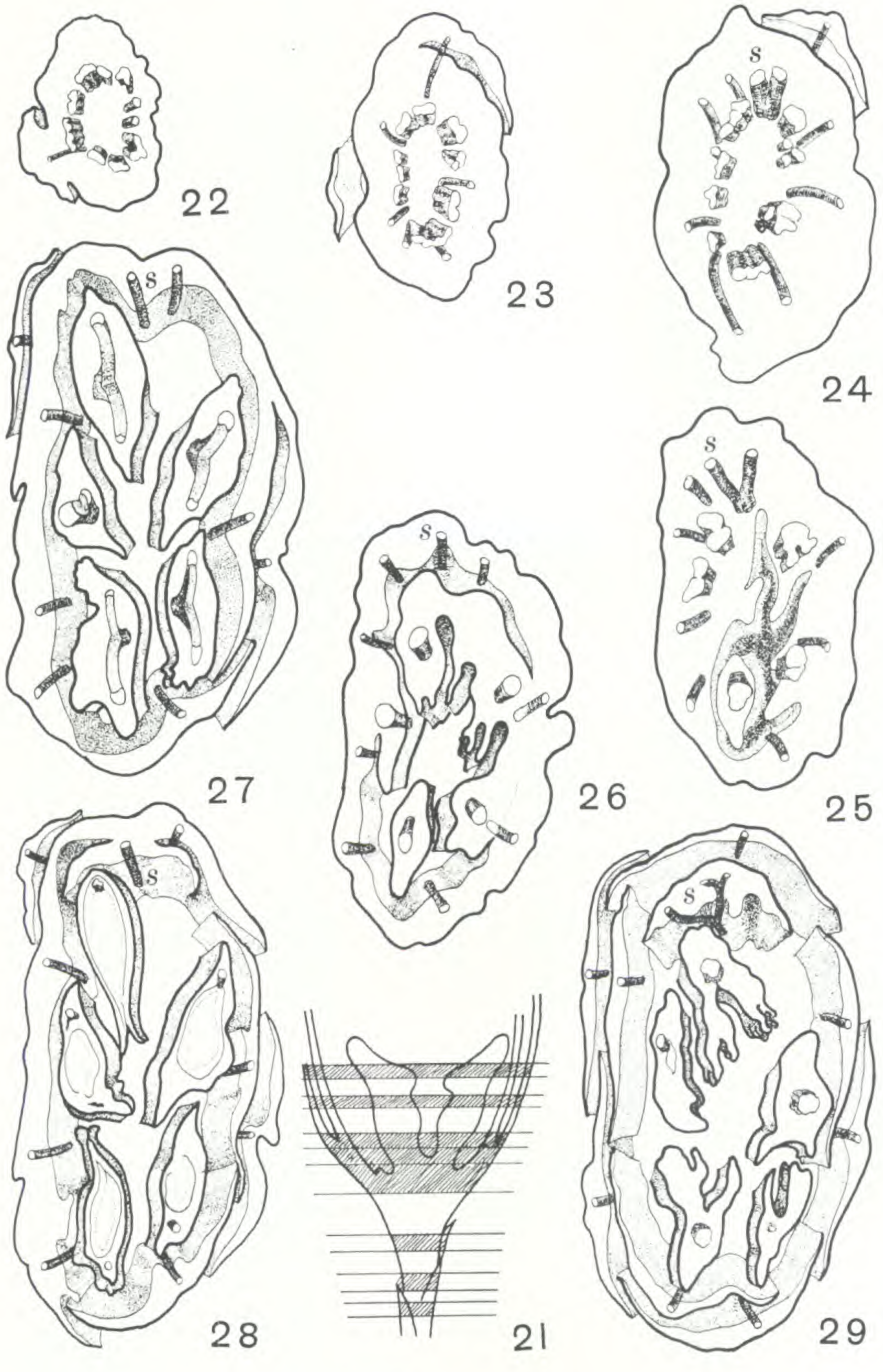

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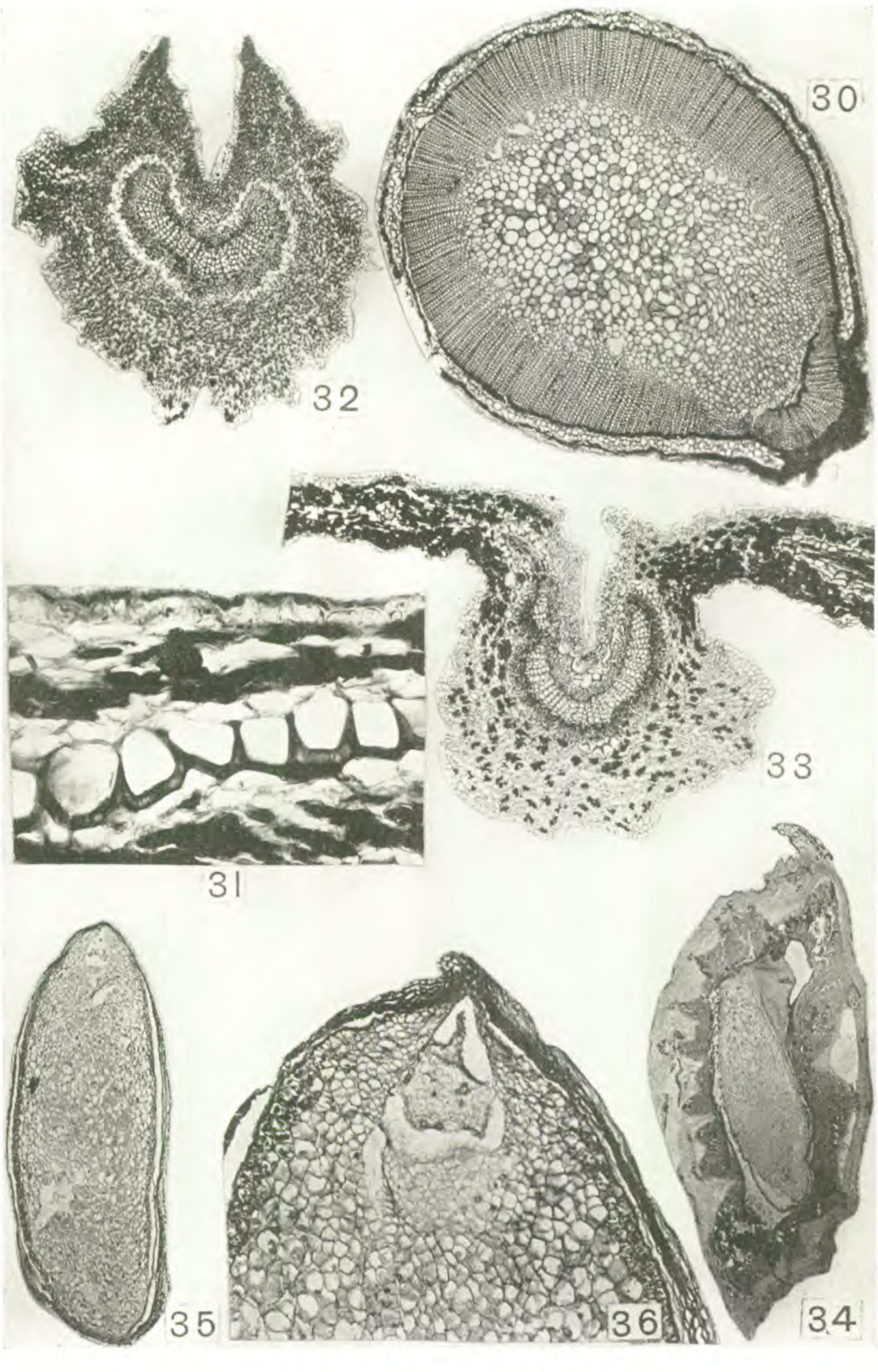

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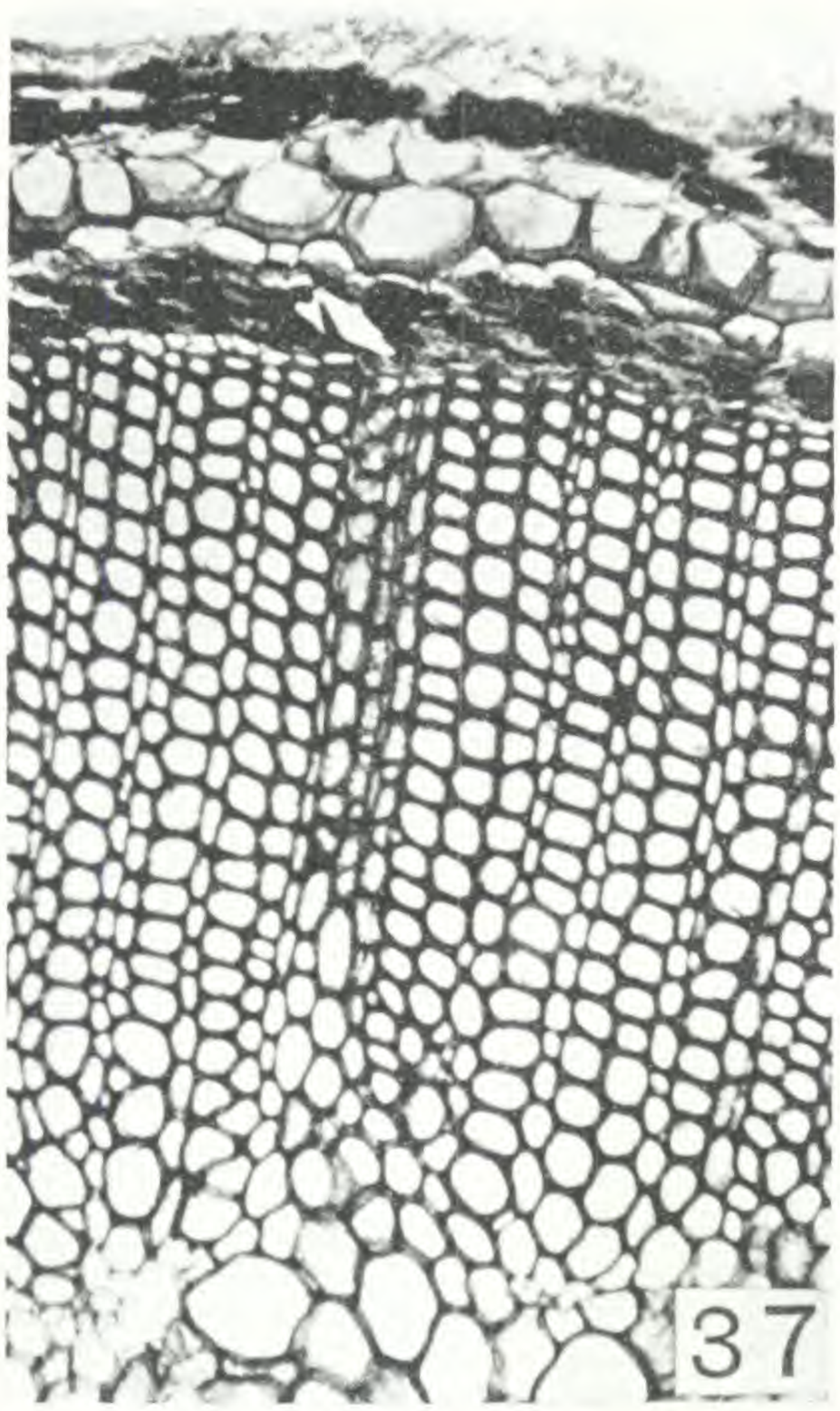

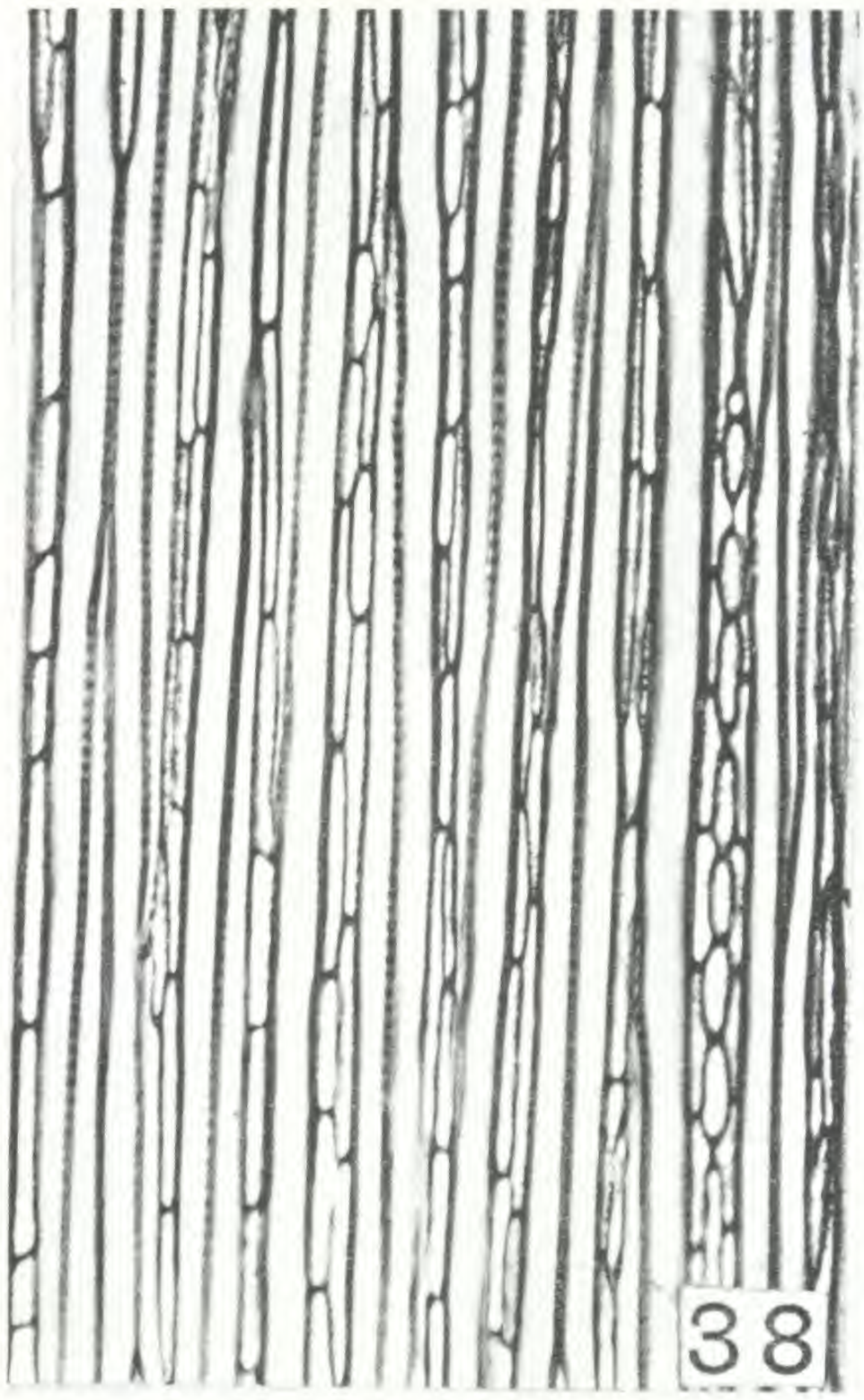

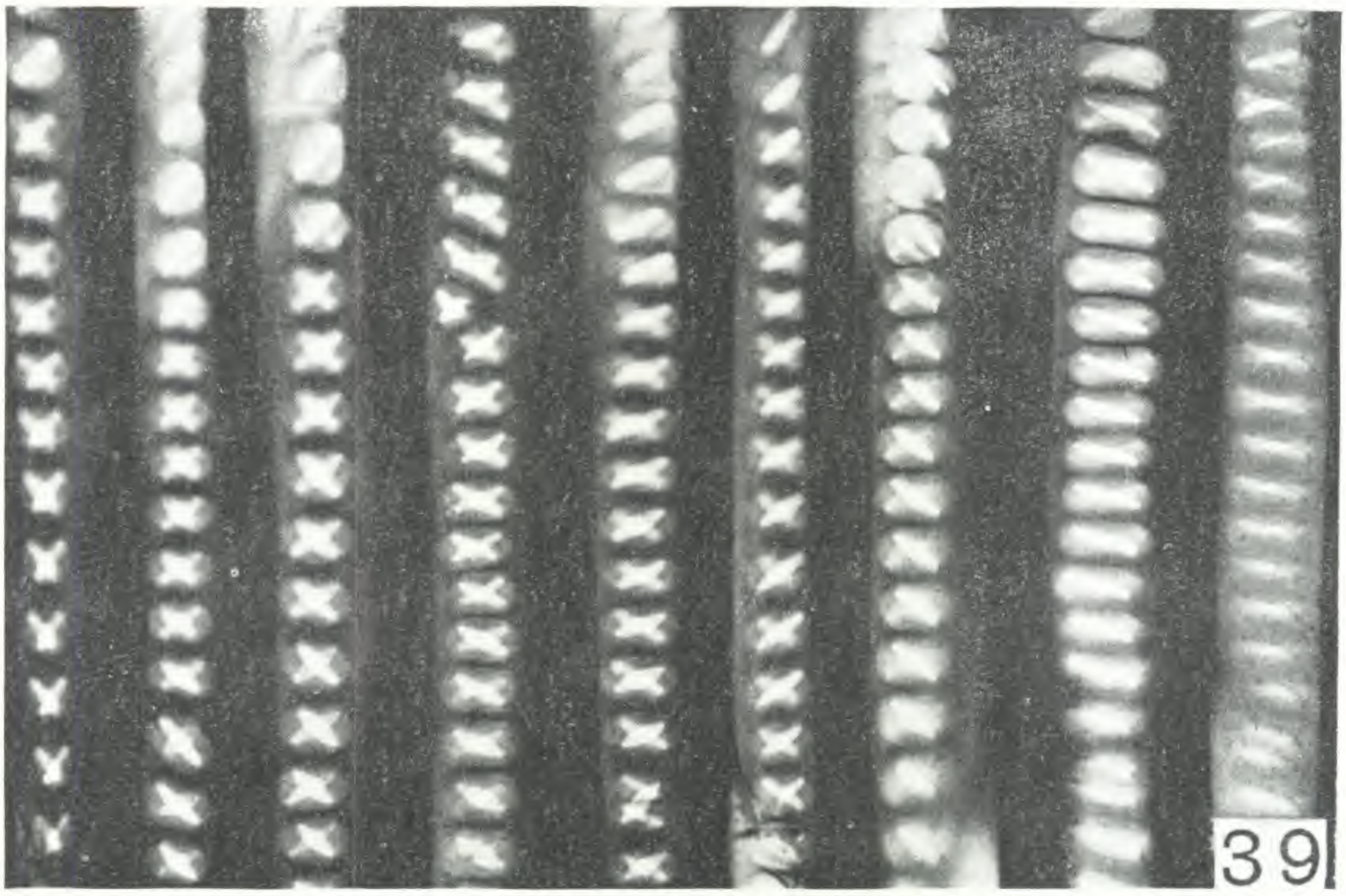

AMBORELLA TRICHOPODA BAILL.

A NEW SPECIES OF AUSTROBAILEYA (AUSTROBAILEYACEAE) FROM AUSTRALIA

C. T. White

Among the many interesting plants collected by Mr. S. F. Kajewski in North Queensland for the Arnold Arboretum in 1929 was *Austrobaileya scandens* C. T. White, described in a general account of the Kajewski collection (Contr. Arn. Arb. 4: 29. *pl. IV*. 1933). As the specimens had been very heavily pressed and rather "over-cooked" in the drying, a satisfactory dissection was difficult and the genus was provisionally placed in the Magnoliaceae. It was later made the type of a subfamily of the Dilleniaceae by Croizat (Jour. Arnold Arb. 21: 404. 1940), who subsequently (Cactus and Succ. Jour. of Cactus & Succ. Soc. America 15: 64. 1943) gave it full family rank.

In 1936, when on a collecting trip (partly financed by the Arnold Arboretum) to Mt. Spurgeon in North Queensland, I collected good flowering material of what I took to be *A. scandens*, and specimens were subsequently distributed from both the Queensland Herbarium and the Arnold Arboretum under this name. Prof. I. W. Bailey, who has recently examined these specimens, wrote me that he considered the Mt. Spurgeon plant a distinct species and sent photographs of stamens and staminodes to bring out some of the differences. On closer examination I have come to the conclusion that Prof. Bailey's contention is correct, and a description is offered herewith.

I have refrained from giving an amended description of the genus until better material of *A. scandens* is available. Several characters perhaps of generic rather than specific value are incorporated in the following description.

Austrobaileya maculata sp. nov.

Frutex glaber, scandens, ramulis teretibus sed ad nodos leviter applanatis. Folia opposita vel subopposita delapsa cicatricem prominentem pulvinatam firmam relinquentia; petioli ca. 2 cm. longi, in sicco cuticula rugulosa obsiti; laminae 12–14 cm. longae, 6.5–8 cm. latae, coriaceae, in sicco utrinque opacae et subtus valde pallidiorae, utrinque prominenter reticulatae, ovato-ellipticae vel fere ovatae; margine recurvae, basi subacutae vel fere obtusae, apice plus vel minus abrupte acuminatae, acumine ipso 1–1.5 cm. longo. Flores axillares, solitarii, pedunculati; pedunculi 0.5–1 cm. longi, basin versus bracteati, bracteis 0.5–1 mm. longis, inferioribus suborbicularibus superioribus ovatis. Perianthii segmenta ca. 21 pallido-viridia ab extimo minimo ad intima petaloidea gradatim sed plus vel minus irregulariter mutata, segmenta minima latissime ovata 2 mm. longa, maxima oblonga 2 cm. longa, 1 cm. lata. Stamina 9, filamentis petaloideis pallido-viridibus maculis purpureis elevatis papillosis dense

notatis, 1 cm. longis, 0.4 cm. latis, antheris 3 mm. longis, introrsis 2-locularibus, loculis parallelibus longitudinaliter dehiscentibus filamenti ad faciem interiorem per totam longitudinem eorum affixis. Staminodia 16 staminis angustiora utrinque maculis purpureis densissime notata. Discus 3 mm. altus firme carnosus. Carpella 9, superiora, libera, cum stylo 7 mm. longa, stylo ipso 4 mm. longo ad apicem bifido, ovulis ca. 9 in placentis 2 parietalibus biseriatim dispositis.

QUEENSLAND: Cook District: Mt. Spurgeon, alt. ca. 4000 ft., rain-forest, *C. T. White 10734* (fls.) Sept. 1936 (large climber, perianth-segments pale green, outermost ones small, gradually larger towards the centre of the flower; stamens pale green, those of the outermost series the largest, marked with purple spots, few on the outer face, more on the inner; stamens of the inner series (staminodia) densely purple-spotted both inside and out; carpels yellow). TYPE in Herb. Brisbane.

Distributed from Herb. Brisbane and Arnold Arboretum as *A. scandens* C. T. White.

Very distinct from the only previously known species of the genus, *A. scandens* C. T. White; the two species can be easily distinguished as follows:

Leaves (in dried specimens) nitid, elliptic to lanceolate; stamens and staminodes pale green, blunt at the top.....*A. scandens.*

Leaves (in dried specimens) dull, elliptic-ovate to ovate; stamens and staminodes pale green, very densely marked with raised papillose spots; stamens pointed at the top .....*A. maculata.*

BOTANIC MUSEUM AND HERBARIUM,
BRISBANE, QUEENSLAND,
AUSTRALIA.

THE GRAMINEAE-PANICOIDEAE OF NEW GUINEA*

JOHN R. REEDER

With seven plates

INTRODUCTION

NO COMPREHENSIVE treatment of the Gramineae of New Guinea has yet been published. Several papers dealing with the known species of this island and adjacent regions have appeared, the more extensive being those by Hackel (24),[1] Schumann and Lauterbach (69, 70), and Hitchcock (33, 35) and Chase (17, 18). With the exception of the botanical novelties, all of the above are merely lists of the species with citations of the specimens examined, although critical notes are sometimes included.

The works dealing with the grasses of this region are widely scattered in botanical literature, many in publications which are unavailable except to those having access to extensive botanical libraries. The present paper is an attempt to bring this information together in readily available form for easy consultation by anyone interested in New Guinea grasses.

The original plan was to study the entire family in New Guinea, but the task proved too great for the time which was available. The subfamily Panicoideae was studied first, since it appeared to present more taxonomic problems than the Festucoideae. It is the hope of the writer that in the near future he will be able to study this other subfamily and thus make our knowledge of the Gramineae of New Guinea easily accessible.

The present paper represents a systematic study of one subfamily, the Panicoideae.[2] All of the species are described and keys to the tribes, genera, and species are included. The subfamily Panicoideae, as treated here, consists of the three tribes, Paniceae, Andropogoneae, and Maydeae. This is the delimitation accepted by most modern students of the group,[3] although it is a somewhat more limited concept than that of Hackel (21). Actually Pilger includes another tribe, the Arthropogoneae, but none of the four genera which he includes in it occurs in New Guinea. This subfamily contains more than half the grass genera found in New Guinea, many of which are extremely complex taxonomically.

* A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Biology, Harvard University, June 1947.

1 For citation of bibliography and list of exsiccatae, see end of Part II in the next number of this Journal.

2 In addition to New Guinea itself, when available, specimens from the Bismarck Archipelago and Solomon Islands are also cited.

3 See Hubbard (37) and Pilger (59).

The work was carried out chiefly at the United States National Herbarium and is based principally upon the rather extensive New Guinea collections at that institution, at the Gray Herbarium and Arnold Arboretum of Harvard University, and at the Britton Herbarium of the New York Botanical Garden. Because of conditions as a result of the recent war, it has been impossible to secure the loan of material from Buitenzorg, Java, and from certain herbaria in Europe. These collections might have included some additions to the grass flora, but it is believed that the present account is reasonably complete.

In addition to the actual New Guinea collections, the United States National Herbarium has abundant material representing the grass family from all parts of the world. The extensive Philippine and Chinese reference collections have served as an invaluable aid during this study. Largely through the efforts of Mrs. Agnes Chase and the late Dr. A. S. Hitchcock, the Grass Herbarium of this institution is rich in type material. In addition to actual types and type duplicates, there are numerous fragments of types accompanied by notes and often by photographs. Some of these fragments may well represent the only type record of that species now in existence because of losses suffered by foreign herbaria during the war. In connection with the Grass Herbarium, Mrs. Chase and Dr. Hitchcock are also responsible for the assembing, over a period of about fifty years, of an extensive agrostological library which is remarkably complete. This library as well as the collections has greatly facilitated this study.

An attempt has been made to account for every published binomial belonging to this subfamily, as recorded from New Guinea, from the time of the earliest explorations until the present date. Sources of all names are cited and an effort is made to clarify the often complicated synonymy in those cases in which references to binomials are found in literature concerning New Guinea. The grass family is such a large and critical group that the number of names under certain species is often very large. For this reason no attempt is made to account for all the synonyms of a given binomial unless they have been accepted as valid names in works dealing specifically with New Guinea plants. In citing the accepted binomial and its synonyms, in addition to the place of original publication, other references to works in which the same species has been considered more or less critically and references to illustrations are often added. In those cases in which the binomial has been used in literature relating directly to New Guinea, the place of publication of the first such report is also cited.

In adopting generic limitations used by most modern authors, 52 genera are recognized as occurring in New Guinea. Of these, 22 are included in the Tribe Paniceae, 27 in Andropogoneae, and 3 in Maydeae. Many of the genera contain species which have an extremely wide range in the tropics, some are weedy species which occur also in temperate regions and are obviously introductions, while others, mostly those of rather high altitudes, appear to be endemic.

With the exception of a few doubtful ones, a total of 133 species, 3 subspecies, and 17 varieties is recognized in this study. This is more than five times the number of species known to Hackel in 1890 (24), and more than twice the number reported by Schumann and Lauterbach in 1901–1905 (69, 70). Hitchcock (33) and Chase (17, 18) together enumerated 96 species and 7 varieties in 1935–1943, but their reports were based entirely upon the collections of the three Archbold Expeditions. These expeditions were sponsored by Mr. Richard Archbold, his Archbold Expeditions being affiliated with the American Museum of Natural History. The first expedition was based on Port Moresby and explorations extended inward to the summit of the Owen Stanley Range, the second was an extended trip up the Fly River, and the third explored the Mount Wilhelmina region of central Netherlands New Guinea. The excellent botanical collections were made by Mr. L. J. Brass, who was assisted, when in Netherlands New Guinea, by Mr. C. Versteegh and Dr. E. Meyer-Drees. The botanical collections assembled on these three extensive expeditions were turned over to Dr. E. D. Merrill for study and for distribution of the duplicate sets. In as far as grasses are concerned, these collections are the most extensive which have thus far come out of New Guinea. They have served as a basis for the present study, but in addition there have been available numerous collections made by Mrs. M. S. Clemens in Northeast New Guinea, by Mr. C. E. Carr in British New Guinea, and small collections made by the writer and other servicemen stationed in the region during the recent war. Shortly before the war, the Arnold Arboretum was fortunate in receiving practically a complete set of duplicates of the collections made in Netherlands New Guinea in 1940 by R. Kanehira and S. Hatusima. The grasses from this collection proved invaluable in interpreting the new species described by J. Ohwi (56). Much of this large island is still unknown botanically, and it is to be expected that future explorations will yield new records, as well as a considerable number of novelties.

In the present work the systematic order of the genera under the tribes follows, in the main, that of Pilger (59). In characterizing the accepted genera, the original descriptions and later ones by other authors have been consulted, and these descriptions have been studied in association with extensive collections of both Old and New World material. Within recent years there has been a tendency among some agrostologists to subdivide large genera into smaller groups. Where these small genera seem to be reasonably well defined, they have been recognized in this work; when, on the other hand, there seems to be a large amount of intergradation between them and the genera from which they have been segregated, they have been rejected. In general I have taken a rather conservative attitude somewhere, perhaps, midway between that of Hitchcock (34) and Stapf (71), but probably closer to the concept of the former author. These conclusions were, in large part, based upon the study of Malaysian material and hence must be regarded as somewhat tentative. The descrip-

tions of the species herein presented are based on the original diagnoses, supplementary data provided by later authors, and an actual examination of all available specimens. Whenever type material was available, it was consulted and the New Guinea specimens were critically compared with it.

During the course of this study it was found desirable to describe a certain number of new species and varieties and to make some new combinations; at the same time certain species have been reduced to synonymy. In one case a new name had to be given to an old species, since the original specific epithet had an earlier homonym in the proper genus. A list of the new names is given below:

Panicum creperum nom. nov.
Panicum mindanaense Merr. var. *pilosum* var. nov.
Brachiaria fusiformis sp. nov.
Brachiaria subquadripara (Trin.) Hitchc. var. *piligera* (F. Muell. ex Benth.) comb. nov.
Cyrtococcum patens (L.) A. Camus var. *Warburgii* (Mez) comb. nov.
Digitaria abortiva sp. nov.
Setaria montana sp. nov.
Isachne obtecta sp. nov.
Isachne villosa (Hitchc.) comb. nov.
Dimeria monostachya sp. nov.
Dimeria dipteros sp. nov.
Dimeria ciliata Merr. var. *heteromorpha* var. nov.
Eulalia irritans (R. Br.) Kuntze var. *egregia* var. nov.
Microstegium ciliatum (Trin.) A. Camus var. *laxum* (Nees ex Steud.) comb. nov.
Ischaemum littorale sp. nov.
Hemarthria subulata sp. nov.
Eremochloa ciliaris (L.) Merr. var. *elata* var. nov.
Rottboellia rottboellioides (R. Br.) comb. nov.
Chrysopogon filipes (Benth.) comb. nov.
Chrysopogon filipes (Benth.) Reeder var. *arundinaceus* var. nov.
Andropogon micranthus Kunth var. *multicispiculus* (Ohwi) comb. nov.
Andropogon brevifolius Swartz var. *cryptopodus* (Ohwi) comb. nov.
Andropogon spicigerus (S. T. Blake) comb. nov.
Themeda gigantea (Cav.) Hack. var. *novoguineensis* var. nov.

The place of deposit of the type specimens of the new species and varieties is given with the citation of specimens. Since the most representative specimen was always selected as the type, they are of necessity not all in the same herbarium.

The dates of collection of the specimens cited are omitted except in the case of types. The island of New Guinea is divided into two parts by a line running north and south essentially through its center. To the west of this line is Netherlands New Guinea, administered by the Netherlands government; the eastern part is divided into two subdivisions, Northeast New Guinea (Kaiser Wilhelmsland of the Germans) to the north and British New Guinea (Papua) to the south. British and Northeast New Guinea are further subdivided into divisions and districts. In citing the specimens the order is as follows: British New Guinea, Northeast New Guinea, Netherlands New Guinea, New Britain (or other islands of the Bismarck Archipelago), and Solomon Islands. A more exact location is

given whenever possible by using the division or district name. Precise localities are given according to what data are available on the labels. In addition notes concerning habitat are also cited whenever these are available on the labels. This latter practice seemed desirable since the collections from New Guinea are not extensive enough to permit of making a general statement as to the habitat.

Abbreviations used in designating the herbaria in which cited specimens are deposited are as follows:

A — Arnold Arboretum of Harvard University
GH — Gray Herbarium of Harvard University
NY — Britton Herbarium, New York Botanical Garden
US — United States National Herbarium.

ACKNOWLEDGEMENTS

This work was done under the direction of Professor E. D. Merrill, to whom I wish to express my sincere appreciation for guidance and the many helpful suggestions given throughout the progress of the study. Grateful acknowledgement is due the administration of Harvard University for granting me a Sheldon Travelling Fellowship, which enabled me to spend more than six months at the National Herbarium in Washington, D. C., where I had access to extensive reference collections and many types. I am indebted to Mr. E. P. Killip, Head Curator of the National Herbarium, for making the collections and facilities of that institution available. To other members of the National Herbarium staff who have directly or indirectly aided in this study, I wish to express my thanks, especially to Mrs. Agnes Chase, who, in addition to her many valuable criticisms, has read the manuscript in its entirety, and to Drs. E. H. Walker and F. A. McClure for their many practical suggestions and criticisms. I wish to thank the members of the Arnold Arboretum staff who have aided me in various ways. Thanks are due also to Dr. H. Hara of the Imperial University, Tokyo, who courteously supplied fragments of the types of species described from New Guinea by J. Ohwi, and to the Director of the National Herbarium at Melbourne, Australia, who supplied fragments of the F. von Mueller types. I wish especially to thank my wife, Charlotte Goodding Reeder, who prepared the illustrations and also gave invaluable assistance in bibliographic work, typing, proofreading, and in countless other ways. Lastly I am indebted to the curators of the several herbaria listed above, who courteously loaned material for this study, and to Mr. C. E. Hubbard, of the Royal Botanic Gardens, Kew, England, who courteously and promptly answered my queries.

GRAMINEAE

Subfamily PANICOIDEAE

Spikelets typically 2-flowered, the rachilla not prolonged beyond the upper floret; perfect spikelets with the terminal perfect or pistillate floret

and a staminate or neuter floret below, often reduced to the lemma (in *Isachne* sometimes both florets fertile); one glume (or rarely both glumes) wanting; articulation below the spikelets either in the pedicel, the rachis or at the base of a cluster of spikelets, the spikelets falling entire, either singly, in groups, or together with joints of the rachis; spikelets, or at least the fertile florets, often more or less dorsally compressed.

KEY TO THE TRIBES

1. Spikelets perfect or with staminate or neuter and perfect or pistillate spikelets mixed in the same inflorescence and so arranged that a staminate or neuter spikelet is near a perfect or pistillate spikelet (*Spinifex* dioecious).
   2. Spikelets solitary or paired, more or less similar; glumes usually membranous, the first often smaller or sometimes obsolete or wanting; lower lemma mostly like the second glume in texture; upper (fertile) lemma more or less indurated, firmer than the glumes, usually awnless .....I. *Paniceae*.
   2. Spikelets usually paired, one sessile, the other pediceled, similar or more or less unlike, the sessile then usually perfect or pistillate and the pediceled staminate or neuter; lemmas hyaline or membranous, thinner than the glumes, usually awned .....II. *Andropogoneae*.
1. Spikelets unisexual, the staminate and pistillate in different inflorescences or in different parts of the same inflorescence, the pistillate below; lemmas hyaline or membranous, thinner than the glumes.....III. *Maydeae*.

Tribe I. PANICEAE

Spikelets 2-flowered, the lower floret often reduced, solitary or in pairs, similar, perfect (rarely unisexual), usually falling entire at maturity; glumes usually membranous, the first commonly smaller, sometimes obsolete or wanting (very rarely the second also wanting); lower lemma similar to the second glume, at least in texture, rarely more or less indurated, empty or enclosing a staminate flower, the palea present or wanting (bearing a perfect flower in some species of *Isachne*); upper lemma and palea similar in texture, usually indurated, or at least firmer than the glumes, awnless or rarely with a short straight awn from the tip; stigmas 2, stamens usually 3. Annuals or perennials with herbaceous (rarely woody) culms and spikelets borne on a usually continuous rachis of solitary, digitate or scattered spikes or racemes or in open or contracted, sometimes spikelike panicles.

KEY TO THE GENERA

1. Spikelets subtended or surrounded by 1 to many bristles, or the rachis produced beyond the spikelets.
   2. Spikelets perfect.
      3. Bristle single, produced beyond the terminal spikelet of the branch, the branches deciduous, falling with the 1 to several spikelets.....16. *Pseudoraphis*.
      3. Bristles several below each spikelet, or if only one, then the spikelets falling free from the branch.
         4. Bristles united at base into a bur-like involucre permanently enclosing the 2 to several spikelets.....18. *Cenchrus*.
         4. Bristles slender, not united at base.
            5. Spikelets falling free from the bristles; fertile lemma more or less transversely rugose .....15. *Setaria*.
            5. Spikelets falling with the subtending bristles; fertile lemma smooth.....17. *Pennisetum*.
   2. Spikelets unisexual, the staminate and pistillate in spatheate inflorescences on different plants.....20. *Spinifex*.

1. Spikelets neither surrounded by bristles nor the rachis produced beyond the spikelet.
   6. Spikelets more or less laterally compressed or oblique.
      7. Fertile lemma strongly dorsally compressed (see also *Oplismenus*).
         8. Second glume inflated-saccate; fertile lemma stipitate.....6. *Sacciolepis.*
         8. Second glume not inflated-saccate; fertile lemma with lateral appendages or excavations at base, not stipitate.....3. *Ichnanthus.*
      7. Fertile lemma more or less laterally compressed.
         9. First glume about half as long as the spikelet; fertile lemma strongly laterally compressed and gibbous on the back.....8. *Cyrtococcum.*
         9. First glume about as long as the spikelet; fertile lemma not strongly gibbous; second glume uncinate-spiny at maturity.....7. *Pseudechinolaena.*
   6. Spikelets terete or distinctly dorsally compressed (see also *Sacciolepis myosuroides*).
      10. Spikelets dimorphic.
         11. Chasmogamous spikelets borne in small terminal panicles; cleistogamous spikelets borne singly in the axils of the vegetative branches; culms hard and wiry.....9. *Cleistochloa.*
         11. Spikelets of two kinds in the same inflorescence, the upper 4–6 staminate, the lower one or two pistillate or perfect; low strand plants..21. *Thuarea.*
      10. Spikelets alike, all perfect.
         12. Glumes equal or nearly so, often falling free from the rest of the spikelet; florets both alike or the lower somewhat larger.....19. *Isachne.*
         12. Glumes usually unequal, the spikelets falling entire; terminal floret perfect, the lower rudimentary or staminate only and with a lemma of the same texture as the glumes.
            13. Glumes or lemmas or both awned, or if short pointed only, the summit of the fertile palea not enclosed (see also *Panicum ambiguum*).
               14. Racemes digitate or approximate; second glume densely ciliate-winged at maturity; fertile lemma awned.....10. *Alloteropsis.*
               14. Racemes simple or compound, not digitate; second glume not ciliate-winged; fertile lemma awnless or with an awn 0.5 mm. long or less.
                  15. Glumes awned, awn of the first glume the longer....5. *Oplismenus.*
                  15. Glumes awnless or nearly so; sterile lemma awned or awn-tipped.
                     16. Sterile lemma 2-lobed, the delicate awn arising from between the lobes; fertile lemma weakly indurated.....22. *Melinis.*
                     16. Sterile lemma entire; fertile lemma strongly indurated.....4. *Echinochloa.*
            13. Glumes and lemmas awnless (see also *Echinochloa colonum*).
               17. First glume wanting or much reduced.
                  18. Rachilla thickened below the second glume into a ring-like or bead-like callus.....13. *Eriochloa.*
                  18. Rachilla not thickened as above.
                     19. Fertile lemma strongly indurate, the margins inrolled.....14. *Paspalum.*
                     19. Fertile lemma cartilaginous, the margins hyaline, not inrolled.....12. *Digitaria.*
               17. First glume prominent.
                  20. Fertile lemma thin or membranous, the palea not enclosed at summit; panicle spikelike.....11. *Hymenachne.*
                  20. Fertile lemma chartaceous-indurate, clasping the palea to its summit.
                     21. Spikelets in few to many spikelike racemes; first glume turned toward the rachis.....2. *Brachiaria.*
                     21. Spikelets in open or contracted panicles, or if in racemes the first glume turned away from the rachis.....1. *Panicum.*

1. Panicum L.

Panicum L., Sp. Pl. 55. 1753.

Spikelets more or less dorsally compressed, in open or compact panicles, rarely in racemes, the back of the fertile lemma turned toward the rachis; glumes 2, membranous, usually unequal, the first often minute, the second usually as long as the spikelet (rarely the first glume as long as the spikelet or the second somewhat shorter); sterile lemma membranous or rarely slightly indurate, usually enclosing a membranous or hyaline palea and sometimes a staminate flower; fertile lemma chartaceous to strongly indurate, the margins inrolled over a palea of the same texture (rarely the margins merely clasping the palea and not strongly inrolled). Annuals or perennials of various habit.

TYPE SPECIES: *Panicum miliaceum* L.

KEY TO THE SPECIES

1. Inflorescence of few to many spikelike racemes rather distant on the axis.
   2. Fertile lemma glabrous, often rugose.
      3. Second glume half to two-thirds as long as the spikelet; fertile lemma acute, minutely beaked ..... 1. *P. distans.*
      3. Second glume as long as the spikelet.
         4. Spikelets 2–4 mm. long; fertile lemma obtuse, mucronate or awned.
            5. Spikelets 3–4 mm. long; first glume acute, nearly as long as the spikelet ..... 2. *P. ambiguum.*
            5. Spikelets 2 mm. long; first glume truncate or mucronate, less than half as long as the spikelet ..... 3. *P. reptans.*
         4. Spikelets 5–7 mm. long; fertile lemma with a short, erose, laterally compressed crest at the apex ..... 6. *P. zizanioides.*
   2. Fertile lemma pubescent ..... 15. *P. marginatum.*
1. Inflorescence not as above, usually a diffuse panicle.
   6. Second glume shorter than the spikelet; fertile lemma weakly indurate.
      7. Glumes unequal, the second half to three-fourths as long as the spikelet ..... 4. *P. nodosum.*
      7. Glumes about equal, about one-third as long as the spikelet .. 5. *P. creperum.*
   6. Second glume as long as the spikelet.
      8. First glume as long as the spikelet or nearly so.
         9. Spikelets 2–2.8 mm. long; sheath surface glabrous (pilose in var. *pilosa*) ..... 11. *P. mindanaense.*
         9. Spikelets 3.2–3.5 mm. long; sheaths papillose-hirsute .... 12. *P. macrocladum.*
      8. First glume half as long as the spikelet or shorter.
         10. Sheaths tuberculate-hispid.
            11. First glume one-third as long as the spikelet, obtuse; blades 8–15 mm. wide ..... 9. *P. cambogiense.*
            11. First glume half as long as the spikelet, acute; blades 2–4 mm. wide .... 10. *P. viale.*
         10. Sheaths not tuberculate-hispid.
            12. Blades 8–25 mm. wide; culms stout, often somewhat woody.
               13. Spikelets 3–4 mm. long; first glume hyaline ..... 8. *P. paludosum.*
               13. Spikelets 2–2.5 mm. long; first glume membranous.
                  14. Ligule membranous; fertile lemma weakly indurated, pale at maturity ..... 7. *P. auritum.*
                  14. Ligule a ring of hairs; fertile lemma strongly indurated, brown at maturity ..... 13. *P. sarmentosum.*
            12. Blades 3–6 mm. wide; culms slender.
               15. Fertile lemma glabrous; ligule membranous ..... 14. *P. Archboldii.*
               15. Fertile lemma pubescent; ligule a ring of hairs ..... 15. *P. marginatum.*

1. **Panicum distans** Trin., Sp. Gram. Ic. 2: *pl. 172.* 1829; Hitchc., Brittonia 2: 121. 1936. Type from Australia.
Paspalidium distans (Trin.) Hughes, Kew Bull. 1923: 318. 1923.

Perennial; culms glabrous, ascending or spreading, 20–70 cm. tall; sheaths shorter than the internodes, ciliate on the overlapping margins; ligule membranous, ciliate, about 0.5 mm. long; blades linear, flat, as much as 15 cm. long, 2–5 mm. wide, sharply narrowed to a very short petiole-like base, more or less scabrous, especially on the margins; inflorescence as much as 20 cm. long, consisting of several to many short racemes 1–4 cm. distant on the slender scabrous axis; basal racemes as much as 3 cm. long, sometimes with a few short branches, the apical racemes reduced to a few spikelets; spikelets crowded, glabrous, very turgid, about 2 mm. long, the pedicels discoid-tipped; first glume about one-third the length of the spikelet with 3 strong nerves (sometimes with 1 or 2 additional pairs of faint nerves); second glume about two-thirds the length of the spikelet, 7-nerved; sterile lemma as long as the spikelet, 5-nerved, the palea poorly developed; fertile lemma minutely beaked, transversely rugose on the lower half, granular-roughened above, the margins strongly inrolled.

British New Guinea: Western Division: Wuroi, Oriomo River, alt. 10–30 m., *Brass 5828* (GH, US) (damp situations on savannah); Daru Island, *Brass 6387* (A, US) (occasional on wet soils in savannah forests); Gaima, Lower Fly River, *Brass 8343* (A, US) (damper parts of savannah forest); Tarara, Wassi Kussa River, *Brass 8696* (A, US) (weed in villages).

Australia and New Guinea.

2. **Panicum ambiguum** Trin., Mém. Acad. St. Petersb. VI. Sci. Nat. 1: 245. 1834; Hack., Bot. Jahrb. 6: 234. 1855. Based on *Urochloa paspaloides* Presl.
Urochloa paspaloides Presl, Rel. Haenk. 1: 318. 1830 (non *Panicum paspaloides* Pers. 1805, nec Hayata 1911); Scribn., Missouri Bot. Gard. Rep. 10: 54. *pl. 14.* 1899. Type from the Philippines.
Brachiaria ambigua (Trin.) A. Camus in Lecomte, Fl. Gén. Indo-Chine 7: 433. 1922.
Brachiaria paspaloides (Presl) C. E. Hubb., Hook. Ic. 34: sub *pl. 3363.* 1938.
Urochloa ambigua (Trin.) Pilger, Nat. Pflanzenfam. ed. 2. 14e: 35. 1940.

Culms ascending to decumbent and creeping, branching, up to 1 meter or more long, glabrous except for the more or less pubescent nodes; sheaths slightly shorter than the internodes, glabrous to more or less pubescent, the margins often ciliate, especially toward the ligule; ligule about 1 mm. long, consisting of a row of whitish hairs or the lower part somewhat membranous; blades flat, 8–15 cm. long, 5–8 mm. wide, glabrous to more or less pubescent, often papillose-hispid along the nerves; inflorescence of 3–7 racemes (rarely only 2), 2–4 cm. long, alternate and 1–2 cm. distant along the slender flattened axis, this more or less pubescent and scabrous along the margins; rachis about 0.75 mm. wide, pubescent to nearly glabrous. the margins scabrous; spikelets paired, glabrous, short-pedicellate, 3–4 mm. long; glumes 5-nerved, the first about four-fifths as long as the second, this equaling the spikelet; sterile lemma 5-nerved, slightly indurate and faintly transversely-rugose on the back, enclosing a minute palea; fertile lemma stramineous, indurate, transversely-rugose and with a terminal awn about 0.5 mm. long, this enclosed within the tip of the sterile lemma.

Northeast New Guinea: Morobe District: Finschhafen, *Clemens 4280* (A, US). Netherlands New Guinea: Triton Bay, *Hombron 1841* (US).

3. **Panicum reptans** L., Syst. Nat. ed. 10. 2: 870. 1759; Hitchc. and Chase, Contr. U. S. Nat. Herb. 15: 36. *fig. 17.* 1910; Chase, Jour. Arnold Arb. 20: 308. 1939. Type from Jamaica.

Panicum prostratum Lam., Tabl. Encycl. 1: 171. 1791; K. Schum. and Lauterb., Nächtr. Fl. Deutsch. Schutzgeb. Südsee 56. 1905. Type from Santo Domingo.
Brachiaria prostrata (Lam.) Griseb., Abh. Boehm. Ges. Wiss. 7: 263. 1857.
Urochloa reptans (L.) Stapf in Prain, Fl. Trop. Afr. 9: 601. 1920.
Brachiaria reptans (L.) C. A. Gard. and C. E. Hubb., Hook. Ic. 34: sub *pl. 3363.* 1938.

Culms slender, decumbent or prostrate, the upright flowering branches 10–40 cm. tall, glabrous except for the more or less pubescent nodes; sheaths shorter than the internodes, glabrous to somewhat papillose-pilose, the margins ciliate; ligule a row of white hairs about 1 mm. long; blades lanceolate, cordate at base, 1–6 cm. long, 4–10 mm. wide, glabrous to sparsely hispid, the margins scabrous; racemes 3–10, 1–3 cm. long, erect or spreading, somewhat distant on the scabrous, angled axis; spikelets crowded, about 2 mm. long, ovate, acute, the pedicels discoid-tipped and often with long stiff hairs as long as the spikelets; first glume about 0.5 mm. long, hyaline, nerveless, truncate or apiculate; second glume as long as the spikelet, 7–9-nerved; sterile lemma 5-nerved and with a well-developed palea; fertile lemma transversely rugose, obtuse and mucronate, the mucro slender.

BRITISH NEW GUINEA: Central Division: Kanosia, *Carr 11091* (NY) (open clearings in forest); Western Division: Daru Island, *Brass 6303* (A, US) (matted on damp soil in native garden clearings). NORTHEAST NEW GUINEA: *Weinland* in 1889–91 (US); Morobe District: Four miles south of Langemak Bay, near Finschhafen, *Sawyer 91* (A); Kajabit, *Clemens 10475* (US).

Widely distributed in the tropics and subtropics.

4. **Panicum nodosum** Kunth,[4] Rev. Gram. 1: Suppl. 9. 1830; K. Schum. and Lauterb., Nächtr. Fl. Deutsch. Schutzgeb. Südsee 56. 1905. Based on *P. multinode* Presl.
Panicum multinode Presl, Rel. Haenk. 1: 303. 1830 (non Lam. 1797). Type from the Philippines.
Panicum Arnottianum Nees in Steud., Syn. Pl. Glum. 1: 59. 1854. Habitat in India and Java.
Hemigymnia multinodis (Presl) Stapf in Prain, Fl. Trop. Afr. 9: 742. 1920.
Hemigymnia Arnottiana (Nees) Stapf in Prain, Fl. Trop. Afr. 9: 742. 1920.
Ottochloa nodosa (Kunth) Dandy, Jour. Bot. 69: 55. 1931.
Ottochloa Arnottiana (Nees) Dandy, Jour. Bot. 69: 55. 1931; Henr., Blumea 4: 531. 1941.

Culms creeping, slender, sparingly branching from the lower nodes, glabrous; sheaths more or less papillose-pilose, ciliate on the margins; ligule membranous, about 0.3 mm. long; blades thin, lanceolate, rounded to subcordate at base, 4–12 cm. long, 5–12 mm. wide, glabrous to more or less papillose-pilose; panicle contracted to more or less open, the slender branches angled, scabrous on the angles; spikelets lanceolate, glabrous to more or less pubescent, 2.8–3.2 mm. long; first glume 1–1.5 mm. long, acute, 3–5-nerved; second glume half to three-fourths as long as the spikelet, 5–7-nerved; sterile lemma equaling the spikelet, 7-nerved; fertile lemma pale, chartaceous-indurate, the tip laterally compressed into a tiny crest.

BRITISH NEW GUINEA: Central Division: Kanosia, *Carr 11032* (NY); Western Division: Daru Island, *Brass 6260* (A, US) (abundant and covering ground under shade of rain-forest margins); Goodenough Island: Ma-

[4] For a discussion of this binomial and more complete synonymy, see Merrill, Bull. Torr. Bot. Club 60: 637. 1933.

launa Creek, *Burcham 128* (US) (scanty moist soil along creek bed and banks).
Africa, Indo-Malayan region to Australia and New Guinea.

5. **Panicum creperum** nom. nov.
Hemigymnia fusca Ridley, Fl. Malay Pen. 5: 228. 1928. Type from Malaya.
Ottochloa fusca (Ridley) Dandy, Jour. Bot. 69: 55. 1931; Henr., Blumea 4: 531. 1941.

Perennial; culms creeping, somewhat woody below, the ascending branches 30–120 cm. tall; sheaths shorter than the internodes, glabrous, often ciliate on the margins; ligule membranous, about 0.3 mm. long; blades glabrous, lanceolate, 10–20 cm. long, 7–15 mm. wide; panicle nodding, 15–25 cm. long, the slender, angled, scabrous branches ascending, as much as 14 cm. long; spikelets glabrous, 2.5–3 mm. long, brown, crowded in short racemes on the panicle branches; glumes about equal or the second slightly longer, about one-third as long as the spikelet, acute or obtuse; sterile lemma equaling the spikelet or slightly shorter; fertile lemma chartaceous-indurate, the tip laterally compressed into a tiny crest.

British New Guinea: Central Division: Veiya, *Carr 11622* (US, NY) (river bank).
Indo-China, Malaya, Sumatra to New Guinea.

Closely related to *Panicum nodosum* Kunth, but differing in the somewhat woody culms, larger blades, and the shorter nearly equal glumes.

Since the specific epithet "*fuscum*" is preoccupied in *Panicum*, a new name is proposed.

6. **Panicum zizanioides** H.B.K., Nov. Gen. et Sp. 1: 100. 1815; Hitchc. & Chase, Contr. U. S. Nat. Herb. 15: 325. *fig. 367*. 1910; Chase, Jour. Arnold Arb. 24: 66. 1943. Type from Colombia.
Panicum oryzoides Swartz, Prodr. Veg. Ind. Occ. 23. 1788 (non Ard. 1764). Type from Jamaica.
Acroceras oryzoides (Swartz) Stapf in Prain, Fl. Trop. Afr. 9: 622. 1920.
Acroceras zizanioides (H.B.K.) Dandy, Jour. Bot. 69: 54. 1931.

Perennial; culms decumbent at base, rooting and rather sparsely branching from the lower nodes, rather robust, the flowering portion ascending or spreading, as much as 1 meter long, glabrous or with a few appressed hairs below the nodes; sheaths ciliate on the margin, sometimes papillose-hirsute toward the summit, otherwise glabrous; ligule membranous, about 0.5 mm. long; blades ovate-lanceolate, 4–15 cm. long, 10–30 mm. wide, subcordate at base, glabrous or rarely with a few appressed hairs; panicle 10–25 cm. long, composed of a few ascending or appressed, stiff, slender, angled, scabrous branches, with short-pediceled more or less secund spikelets; spikelets 5.5–7 mm. long, rather turgid; first glume about two-thirds as long as the spikelet, acute, 3–5-nerved; second glume and sterile lemma equal, abruptly contracted into a short keeled tip, 5-nerved, the lateral nerves of the lemma more or less obscure below the tip; sterile palea about two-thirds as long as the lemma; fertile lemma smooth and shining and with a short, erose, laterally compressed crest at the apex, the tip of the palea similarly compressed and bent outward.

Netherlands New Guinea: Bernhard Camp, Idenburg River, alt. 50 m., *Brass 13946* (A, US) (abundant in semi-open swampy forest of river flood plain).
Tropical America, Africa, India, and New Guinea.

7. **Panicum auritum** Presl ex Nees, Agros. Bras. 176. 1829; Presl, Rel. Haenk. 1: 305.

1830; Scribn., Missouri Bot. Gard. Rep. 10: 46. *pl. 15*. 1899; Chase, Jour. Arnold Arb. 24: 86. 1943. Type from Luzon, Philippines.

Hymenachne aurita (Presl ex Nees) Balansa, Jour. de Bot. 4: 144. 1890;[5] Backer in Heyne, Nutt. Pl. Ned.-Ind. ed. 2. 1: 238. 1927.

Culms glabrous, ascending or spreading, often rather stout, as much as 2 meters tall; sheaths distinctly shorter than the internodes, glabrous or sometimes ciliate on the margins; ligule membranous, about 0.5 mm. long or less; blades lanceolate, acuminate, 10–20 cm. long, 8–25 mm. wide, glabrous, rather firm, subcordate at base, the margins scabrous; panicle 20–40 cm. long, contracted or the branches stiffly spreading, these and the pedicels scabrous; spikelets glabrous, about 2.5 mm. long, broadly lanceolate, acuminate; first glume 3-nerved, about one-third as long as the spikelet, acute or sometimes minutely apiculate; second glume and sterile lemma subequal, 5-nerved, the lemma usually a little shorter, epaleate or with a much reduced palea; fertile lemma chartaceous, thin, stramineous, the margins clasping the palea but not inrolled or only weakly so, the tip of the palea sometimes free.

NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, alt. 50 m., *Brass 13942* (A, US) (common in swamp forests of river silt plains).

Indo-Malayan region to New Guinea.

8. **Panicum paludosum** Roxb., Hort. Beng. 8. 1814. nomen, Fl. Ind. 1: 310. 1820. descr.; K. Schum., Notizbl. Bot. Gart. Berlin 1: 208. 1896. Type from India.

Aquatic perennial; culms decumbent, floating or rooting in the mud, soft, often 1 cm. in diameter, the flowering portion erect or ascending, as much as 1 meter tall; sheaths glabrous, longer than the internodes; ligule a ring of hairs about 2 mm. long; blades thin, 10–30 cm. long, 8–16 mm. wide, scabrous on the margins, scaberulous on the upper surface, nearly smooth below; panicle partly included in the uppermost sheath, at first contracted, finally very diffuse, 15–30 cm. long, the branches angled and scabrous; spikelets very numerous, glabrous, lanceolate, acuminate, 3–4 mm. long; first glume hyaline, acute, about 1 mm. long, with a faint midnerve and sometimes a pair of obscure lateral nerves; second glume and sterile lemma equal or subequal, 7–9-nerved, the lemma enclosing a hyaline palea about two-thirds its length; fertile lemma about 2.5 mm. long, smooth and shining, pale at maturity.

BRITISH NEW GUINEA: Western Division: Middle Fly River, Lake Daviumbu, *Brass 7647* (A) (swampy lakeshore, uncommon). NORTHEAST NEW GUINEA: Morobe District: Near Kajabit Mission, *Clemens 10696* (US).

India to Southern China, Malaya, Philippines, Australia and New Guinea.

9. **Panicum cambogiense** Balansa,[6] Jour. de Bot. 4: 142. 1890. Type from Indo-China.

Panicum caesium Nees, Jour. Bot. Kew Misc. 2: 97. 1850 (non Nees 1836); K. Schum. and Lauterb., Fl. Deutsch. Schutzgeb. Südsee 179. 1901. Type from the Philippines.

Panicum reticulatum Thwaites in Trimen, Jour. Bot. 23: 271. 1885 (non Torr. 1852, nec Griseb. 1857). Type from Ceylon.

Panicum cruciabile Chase, Jour. Arnold Arb. 20: 309. 1939. Based on *P. reticulatum* Thwaites.

[5] Given as "H[ymenachne] aurita Presl," but presumably based on *Panicum auritum* Presl ex Nees.

[6] For a further discussion of the accepted binomial, see Henrard, Blumea 3: 444. 1940.

Robust annual; culms 80–100 cm. tall, rather stout, more or less tuberculate-hispid, especially on the portion not covered by the sheaths, the nodes bearded; sheaths somewhat keeled, especially toward the summit, densely tuberculate-hispid, the hairs stiff and breaking off readily; ligule a row of tawny hairs about 1 mm. long; blades glabrous, as much as 25 cm. long, 8–15 mm. wide; panicle open, 25-40 cm. long, the branches flexuous; spikelets glabrous, about 2 mm. long; first glume about one-third as long as the spikelet, clasping, obtuse, 7-nerved; second glume and sterile lemma equal, 9–11-nerved, the nerves connected here and there by faint cross-nerves giving a reticulate appearance; sterile palea as long as the lemma, hyaline except for the two marginal nerves; fertile lemma smooth and shining, olive-brown at maturity.

BRITISH NEW GUINEA: Northern Division: Ambasi, *Copeland King* in 1912 (US); Western Division: Strickland River, *W. Bauerlen 61* (US). NORTHEAST NEW GUINEA: Dreger Harbor (Finschhafen area), *Reeder 904* (A, US) (low wet ground). SOLOMON ISLANDS: Bougainville: *Kajewski 1897* (GH, US).

Ceylon, Burma, the Philippines, New Guinea, and the Solomon Islands.

10. **Panicum viale** Chase, Jour. Arnold Arb. 20: 310. 1939. Type from New Guinea.

Perennial; culms tufted, erect or ascending, 50–100 cm. tall, sparingly branching, tuberculate-hispid on the portions not covered by the sheaths; sheaths much shorter than the internodes, tuberculate-hispid like the nodes and the exposed parts of the culm; ligule a row of stiff hairs about 1 mm. long; blades flat to subinvolute, rather stiff, 10–20 cm. long, 2–4 mm. wide (blades on the basal sheaths shorter and narrower), papillose-pilose to tuberculate-hispid; panicle open, 20–30 cm. long, the branches flexuous but rather stiff, angled, scabrous, spikelet-bearing toward the ends; spikelets glabrous, 2 mm. long, slightly less than 1 mm. wide, plump, abruptly short-pointed; first glume half as long as the spikelet, clasping, acuminate, with a strong midnerve and 1 or 2 additional pairs of obscure lateral nerves; second glume and sterile lemma equal, 7-nerved; sterile palea hyaline, about three-fourths as long as the lemma; fertile lemma smooth and shining, olive-brown at maturity, the 5 nerves showing as pale stripes.

BRITISH NEW GUINEA: Central Division: Rona, Laloki River, alt. 450 m., *Brass 3631* (A, TYPE, US) (fairly common on roadsides); Kanosia, *Carr 11048, 11104* (US, NY) (open savannah lands); ? Division: Barawara, *MacGregor 21* (US).

Endemic.

Related to *Panicum cambogiense,* but that species is a robust annual with much broader, glabrous leaves and more turgid spikelets in which the first glume is only about one-third as long as the spikelet and is obtuse rather than acuminate. Both species have tuberculate-hispid sheaths. The type specimen (*Brass 3631*) was cited as *Panicum tuberculatum* Presl by Hitchcock (Brittonia 2: 122. 1936).

11. **Panicum mindanaense** Merrill, Philip. Jour. Sci. Bot. 1: Suppl. 360. 1906; Hitchc., Brittonia 2: 121. 1936. Type from Mindanao, Philippines.

Culms caespitose, glabrous, erect or ascending, 20–80 cm. tall; sheaths shorter than the internodes, often somewhat papillose, especially toward the summit, glabrous or with ciliate margins; ligule a ring of stiff hairs 0.5–1 mm. long; blades flat, ascending, mostly 5–15 cm. long, 2–4 mm. wide, glabrous or essentially so; panicle diffuse, 10–15 cm. long, the

slender scabrous branches rather distant, spikelet-bearing toward the ends; spikelets often purplish, 2–2.8 mm. long, glabrous or the midnerve of the glumes scabrous; first glume as long as the spikelet or nearly so, clasping, acuminate, 5–7-nerved, separated from the second glume by a distinct internode; second glume and sterile lemma equal, acuminate, 5–7-nerved, the lemma with a hyaline palea about half its length; fertile lemma elliptic, smooth and shining.

BRITISH NEW GUINEA: Western Division: Dagwa, Oriomo River, alt. 40 m., *Brass 5960* (GH, US) (damp situations on creek flats); Mabaduan, *Brass 6485* (A, US) (common on old grass-grown garden lands, especially on wet soils); Lake Daviumbu, Middle Fly River, *Brass 7522, 7851, 7852* (A, US) (savannahs; tufted on patches of hard ground). NORTHEAST NEW GUINEA: Morobe District: Dreger Harbor, near Finschhafen, *Reeder 905* (A, US) (low, wet ground in the open).

Philippines and New Guinea.

Brass 6485, cited as "? *Panicum papuanum* Mez" by Chase (17, p. 309), is a slightly more robust plant than the others and has blades as much as 20 cm. long. The original description of *P. papuanum* states that the glumes are 7-nerved and that the sterile lemma (glume III) is 9-nerved. *Brass 6486* has both glumes and sterile lemma 5-nerved. The spikelets are identical with those of a type duplicate of *P. mindanaense*.

11a. **Panicum mindanaense** Merr. var. **pilosum** var. nov.

A typo vaginis laminisque dense pilosis differt.

NETHERLANDS NEW GUINEA: Waren, *Kanehira & Hatusima 13093* (A, TYPE) March 26, 1940 (in open dry rocky grass field).

Differs from the species in having the sheaths and blades densely pilose.

12. **Panicum macrocladum** Chase, Jour. Arnold Arb. **20:** 308. 1939. Type from New Guinea.

Panicum Braunii Mez, Bot. Jahrb. 56: Beibl. 125: 5. 1921 (non Steud. 1854). Type from the Bismarck Archipelago.

Culms glabrous, erect or ascending, about 1 meter tall, the nodes often black; sheaths much shorter than the internodes, papillose-hirsute, the upper sometimes nearly glabrous, at least on the lower half; ligule a dense row of hairs about 2 mm. long; blades flat, 18–30 cm. long, 4–7 mm. wide, loosely hirsute on both surfaces or scabrous only toward the attenuate apex, the margins scabrous; panicle partly included in the upper sheath, 40–50 cm. long, nodding, with numerous subcapillary compound branches as much as 25 cm. long, the slender angled axis and branches scabrous, the spikelets mostly aggregated toward the ends of the branchlets; spikelets ovate-lanceolate, acuminate, glabrous, 3.2–3.5 mm. long; first glume from one-fourth shorter to nearly as long as the spikelet, 5–7-nerved, broad, clasping, acuminate; second glume and sterile lemma subequal, 5–7-nerved; fertile lemma 2 mm. long, elliptic, smooth and shining.

BRITISH NEW GUINEA: ? Division: Kuba Kuba, *MacGregor 18* (US); Western Division: Daru Island, *Brass 6350* (A, US) (on swampy ground in savannah forest); Mabaduan, *Brass 6568* (A, TYPE, US) (sporadic on damp soil in savannah forest).

Endemic.

Closely related to *Panicum mindanaense* Merr., from which it differs in being much coarser and taller, with longer and broader leaves and larger spikelets.

13. **Panicum sarmentosum** Roxb., Hort. Beng. 8. 1814, nomen, Fl. Ind. 1: 311. 1820, descr.; K. Schum. and Lauterb., Fl. Deutsch. Schutzgeb. Südsee 179. 1901. Type from Sumatra.

Panicum incomtum Trin., Gram. Pan. 200. 1826, Sp. Gram. Ic. 2: *pl. 232.* 1829; Chase, Jour. Arnold Arb. **20:** 311. 1939. Type from the Philippines.

Perennial; culms branching, woody, scandent or rambling, 1 to several meters long (up to 15 meters ex auct.), glabrous or somewhat pubescent, especially below the panicle; sheaths shorter than the internodes, nearly glabrous to rather densely pubescent, especially on the collar, apparently becoming glabrous in age; ligule a ring of tawny hairs scarcely 1 mm. long; blades glabrous to more or less pubescent, linear-lanceolate, 12–30 cm. long, 8–25 mm. wide, acuminate, the base abruptly narrowed at the junction with the sheath; panicle open, 15–30 cm. long, the main axis erect, pubescent or villous, the branches terete, spreading, often very diffuse and implicate, sometimes viscid; spikelets ovoid, about 2 mm. long, obtuse or subacute, glabrous or with a few short hairs near the tip of the glumes and sterile lemma; first glume half the length of the spikelet or more, acute, 3-nerved; second glume and sterile lemma equal, 5-nerved, the sterile lemma with a palea about two-thirds its length; fertile lemma smooth and shining, angled on the back, brown at maturity.

British New Guinea: Central Division: Mafulu, alt. 1250 m., *Brass 5208* (US) (rambling grass in secondary forest); Koitaki, *Carr 12525* (NY) (edge of forest); Western Division: Lake Daviumbu, Middle Fly River, *Brass 7957* (A, US) (large entangling grass in old village clearings); Mt. Musgrave, *MacGregor 41* (US); ? Division: Lone Range, *Chalmers 72* (US); Without precise locality: *Chalmers 42* (US); *Hartman 73* (US); *MacGregor 12* (US). Northeast New Guinea: Morobe District: *Clemens 4303* (A).

Indo-Malayan region, New Guinea, and Australia.

Roxburgh based his description on plants growing in the Calcutta Botanical Garden, where the species had been introduced from Sumatra. Chase (17, p. 311) and J. Ohwi (56, p. 5) take up the name *Panicum incomtum* Trin. (described from the Philippines) for the New Guinea plants. Chase (loc. cit.) states: "*Panicum sarmentosum* Roxb., described from Sumatra, has a larger much more open panicle than *P. incomtum,* the panicle branches not viscid. It is far less common and less widely distributed than *P. incomtum.*" Study of numerous specimens from the Indo-Malayan region does not support the view that these two species are distinct. There is nothing in the size or structure of the spikelets that would serve to separate two species from the complex, and the panicles vary from open and with spreading branches to more contracted with the branches more or less implicate. There seem to be all degrees of variation between these two extremes. The viscid panicle branches are not always associated with the implicate character. From the evidence at hand it seems to the writer that we have here not two species, one with a wide range, the other rather restricted, as Mrs. Chase suggested, but rather one wide-ranging polymorphic species.

14. **Panicum Archboldii** Hitchc., Brittonia 2: 121. 1936. Type from New Guinea.

Perennial; culms erect, stiff, hard, glabrous, about 1.5 meters tall; sheaths glabrous, shorter than the internodes, somewhat keeled, especially

toward the summit; ligule membranous, about 0.5 mm. long; blades glabrous, erect or ascending, flat to involute, 10–25 cm. long, 3–6 mm. wide; panicle erect, contracted, 10–25 cm. long, the axis angled, scabrous, the main branches slender, appressed, distant but more or less overlapping, the lower as much as 9 cm. long, bearing short-pediceled, closely arranged spikelets mostly toward one side, the branches and terete pedicels minutely scabrous; spikelets 2 mm. long, glabrous, oblong-elliptic; first glume ovate, acute, 5-nerved, less than half as long as the spikelet; second glume and sterile lemma equal, 5-nerved, the lemma with a much reduced hyaline palea; fertile lemma chartaceous-indurate, stramineous, acute.

BRITISH NEW GUINEA: Western Division: Dagwa, Oriomo River, alt. 40 m., *Brass 5923* (US, TYPE COLL.) (shallow margins of a large lagoon); Daru Island, *Brass 6342* (A, US) (occasional pure stands in swampy savannah forests); Mabaduan, *Brass 6484* (A, US) (common in dense grass cover of old garden lands).

Sumatra and New Guinea.

The original description of this species states that the blades are 5–15 cm. long and that the spikelets are loosely arranged on the panicle branches. Examination of a duplicate of the type specimen shows that the blades are, rather, 10–22 cm. long, and that the spikelets are very densely arranged on the panicle branches.

15. **Panicum marginatum** R. Br., Prodr. Fl. Nov. Holl. 1: 190. 1810; Trin., Sp. Gram. Ic. 2: *pl. 209*. 1829; Chase, Jour. Arnold Arb. 20: 312. 1939. Type from Australia.

Entolasia marginata (R. Br.) Hughes, Kew Bull. 1923: 331. 1923.

Perennial; culms ascending or spreading, sparingly branching below, 40–90 cm. tall, essentially glabrous; sheaths distinctly shorter than the internodes, glabrous to rather densely papillose-pilose (sometimes only papillose); ligule a row of hairs about 1 mm. long; blades mostly 3–9 cm. long, 2–6 mm. wide (often much reduced, especially on the basal sheaths), scabrous to more or less pubescent, the base narrowed into a short brownish petiole-like base; panicle erect, contracted, 3–8 cm. long; spikelets glabrous, 3–3.5 mm. long, about 1 mm. wide; first glume about 0.5 mm. long, hyaline and nerveless; second glume and sterile lemma equal, membranous, 5-nerved; fertile lemma and palea white-sericeous.

BRITISH NEW GUINEA: Western Division: Tarara, Wassi-Kussa River, *Brass 8654* (A, US) (forming a wiry, tangled groundcover in riverbank dry scrub).

Australia and New Guinea.

2. **Brachiaria** (Trin.) Griseb.

Brachiaria (Trin.) Griseb. in Ledeb., Fl. Ross. 4: 469. 1853.

Panicum section *Brachiaria* Trin., Mém. Acad. St. Petersb. VI. Sci. Nat. 3(2): 194. 1834.

Spikelets dorsally compressed, solitary or in pairs, alternate in two rows along one side of a trigonal or narrowly winged rachis, the back of the fertile lemma turned away from it; first glume one-third to half as long as the spikelet; second glume and sterile lemma similar, 5–7-nerved, the lemma usually with a palea and sometimes bearing a staminate flower; fertile lemma indurate, dorsally convex, obtuse, acute, or mucronate, smooth or rugose, the margins inrolled. Annuals or perennials with terminal panicles of two to several spikelike racemes racemose along a main axis.

TYPE SPECIES: *Brachiaria eruciformis* (J. E. Smith) Griseb. (*Panicum eruciforme* J. E. Smith).

KEY TO THE SPECIES

1. First glume clasping the base of the spikelet, the margins overlapping; fertile lemma transversely rugose.....1. *B. subquadripara.*
1. First glume not clasping the spikelet; fertile lemma papillose-rugose.
   2. Spikelets about 2.5 mm. long, acute; fertile lemma not mucronate.....2. *B. coccosperma.*
   2. Spikelets about 3 mm. or more long, acuminate or awned; fertile lemma mucronate.
      3. Spikelets silky-sericeous; sterile lemma awned.....4. *B. holosericea.*
      3. Spikelets not silky-sericeous (sometimes with a few silky hairs at apex); sterile lemma awnless.....3. *B. fusiformis.*

1. **Brachiaria subquadripara** (Trin.) Hitchc., Lingnan Sci. Jour. 7: 214. 1929; Chase, Jour. Arnold Arb. 20: 308. 1939.

Panicum subquadriparum Trin., Gram. Pan. 145. 1826, Sp. Gram. Ic. 2: *pl. 186.* 1829. "Inss. Marian. Ind. or."

Panicum miliiforme Presl, Rel. Haenk. 1: 300. 1830; Scribn., Missouri Bot. Gard. Rep. 10: 47. *pl. 20.* 1899. Type from Luzon, Philippines.

Brachiaria miliiforme (Presl) Chase, Contr. U. S. Nat. Herb. 22: 35. 1920.

Culms slender, straggling or suberect, the ascending branches 20–60 cm. tall; sheaths mostly shorter than the internodes, rather loose, glabrous or somewhat pubescent, the margins usually more or less ciliate; ligule a row of hairs about 1 mm. long; blades 5–17 cm. long, 4–10 mm. wide, glabrous or sparsely pilose, the margins scabrous; racemes 3–6, spreading, rather distant along the glabrous or sparsely hairy axis, the rachis flattened, glabrous or sometimes with stiff hairs; spikelets 3–4 mm. long, glabrous, acute, solitary, subsessile on the rachis; first glume about 1.5 mm. long, clasping the base of the spikelet, the margins overlapping; second glume 7-nerved; sterile lemma 5-nerved, equaling the second glume, sometimes enclosing a hyaline palea; fertile lemma pale, transversely rugose.

BRITISH NEW GUINEA: Western Division: Daru Island, *Brass 6301* (A, US) (common as a weed in native gardens); Northern Division: Oro Bay, *Reeder 841* (A, US) (growing thickly in sand along seashore, just above high tide mark). NETHERLANDS NEW GUINEA: Waren, 50 miles south of Manokwari, *Kanehira & Hatusima 14144* (A).

This species has been referred to *Panicum distachyon* L. of India, a smaller species with ovate-lanceolate blades in which the racemes are usually two and the peduncle is pilose near the summit.

1a. **Brachiaria subquadripara** (Trin.) Hitchc. var. **piligera** (F. Muell. ex Benth.) comb. nov.

Panicum piligerum F. Muell. ex Benth., Fl. Austral. 7: 477. 1878. Type from Australia.

Brachiaria piligera (F. Muell. ex Benth.) Hughes, Kew Bull. 1923: 315. 1923.

Differs from the species in having the second glume and sterile lemma pubescent. The first glume is glabrous.

BRITISH NEW GUINEA: Central Division: Hisiu, *Carr 11398* (NY) (open places near the seashore; grass about two feet tall).

2. **Brachiaria coccosperma** (Steud.) Stapf ex Backer, Handb. Fl. Java 2: 147. 1928. (As synonym of *Panicum coccospermum* Steud.)

Panicum coccospermum Steud., Syn. Pl. Glum. 1: 62. 1854. Type from India.

Annual; culms slender, usually decumbent and branching below, 10–35 cm. tall, subglabrous to more or less pubescent, the nodes white-bearded; sheaths usually shorter than the internodes, sparsely to densely woolly-pubescent, the margins ciliate; ligule a row of white hairs about 0.3 mm. long; blades ovate-lanceolate, subcordate, 1–4 cm. long, 3–10 mm. wide, soft-pubescent on both surfaces, one of the margins undulate, the other pectinate-scabrous; racemes 4–8, 1–3 cm. long, the rachis more or less pubescent, scabrous on the angles; pedicels solitary above, often paired below, short, more or less pubescent and bearing stiff hairs as much as 0.5 mm. long; spikelets glabrous to densely soft-pubescent, about 2.5 mm. long; first glume 3-nerved, about half as long as the spikelet, acute; second glume and sterile lemma equal, acute, 5-nerved, the lemma enclosing a well developed palea but no flower; fertile lemma pale, elliptic, longitudinally striate and minutely papillose-rugose.

NORTHEAST NEW GUINEA: Morobe District: Wantoat, *Clemens* (sine coll. no.), Feb. 21, 1940 (US). [Form with glabrous spikelets.]

This species is variable in that the spikelets may vary from glabrous to rather densely pubescent. The foliage also varies in this respect, but to a lesser degree.

Some authors have considered this species as a synonym of *Brachiaria villosa* (Lam.) A. Camus (*Panicum villosum* Lam., Tabl. Encycl. 1: 173. 1791), but that species has obtuse glumes, a sterile lemma enclosing a well developed staminate flower, and both sterile and fertile lemmas mucronate. The tip of the fertile lemma is scabrous and clothed with white hairs on the margin near the apex.

3. **Brachiaria fusiformis** sp. nov. PLATE I.

Annua, 15–40 cm. alta; culmis gracilibus, glabris vel plus minusve pubescentibus, adscendentibus vel decumbentibus, nodis pubescentibus eis inferioribus radicantibus; vaginis quam internodiis fere brevioribus, plus minusve pubescentibus, callo et marginibus dense pilosis; ligula ad ciliarum seriem fere 0.6 mm. longam reducta; laminis ovato-lanceolatis, subcordatis, 1.5–3.5 cm. longis, 3–7 mm. latis, glabris vel plus minusve puberulentibus, alter margine undulato, alter pectinato-scabro; racemis 3–10, 0.5–2 cm. longis, rhachi angulata, puberulente et pilis paucis rigidis praedita; pedicellis solitariis, 0.5–1 mm. longis, puberulentibus et apicem versus pilis rigidibus obtectis; spiculis fusiformibus, circiter 3 mm. longis, pilosis, apicem versus pilis paullo longioribus; gluma prima acuta, 3-nervia, quam spicula duplo breviore; gluma secunda et lemmate sterili subaequantibus, 5-nervis, acuminatis, lemmate quam gluma paullo longiore; palea sterili angusta, scariosa; lemmate fertili striata papillis ordinibus dispositis.

BRITISH NEW GUINEA: Central Division: Rona, Laloki River, alt. 450 m., *Brass 3639* (GH, TYPE, US) April, 1933 (common on rocky savannah slopes).

Some additional specimens in the U. S. National Herbarium which seem to represent this same species are: Luzon: Viscaya Province: *M. Ramos* [Philip. Bur. Sci. No. 8214]; *Clemens 18000;* Benguet Province: *R. S. Williams 1963;* Lepanto District, *Merrill 4459.*

The new species is related to *Brachiaria coccosperma,* but that species has shorter, acute spikelets with the fertile floret elliptic and acute rather than obovate and distinctly mucronate. This is the species reported as *B. villosa* (Lam.) A. Camus, by Hitchcock (35, p. 121).

4. **Brachiaria holosericea** (R. Br.) Hughes, Kew Bull. **1923:** 315. 1923; Hitchc., Brittonia 2: 121. 1936.

Panicum holosericeum R. Br., Prodr. Fl. Nov. Holl. 1: 190. 1810; Trin., Sp. Gram. Ic. 2: *pl. 173.* 1829. Type from Australia.

Culms erect from a branching base, 40–60 cm. tall, glabrous or sparsely pubescent, the nodes densely villous; sheaths, at least the lower, overlapping, sparsely stiff-pilose, densely so along the margins; ligule a row of stiff hairs about 1.5 mm. long; blades lanceolate, 3–5 cm. long, 3–5 mm. wide, stiff-pilose on both surfaces, the margins slightly scaberulous; racemes mostly 5–7, about 1 cm. long, the rachis angled; spikelets short-pediceled, 3–3.5 mm. long, densely sericeous, the long silky hairs on the upper part widely spreading at maturity; first glume acute, about 1.5 mm. long, 3-nerved, the lateral nerves obscure; second glume acuminate, about 2.5 mm. long exclusive of the hairs, 5-nerved, the hairs on the upper half as much as 2 mm. long; sterile lemma similar to the second glume in size and indument, but terminating in a short awn equaling but rarely exceeding the apical hairs; fertile lemma mucronate, longitudinally striate, about 2 mm. long.

British New Guinea: Western Division: Dagwa, Oriomo River, *Brass 5910* (GH, US) (common on damp ridge slopes); Lake Daviumbu, Middle Fly River, *Brass 7810* (A, US) (occasional in savannah grass cover).

Australia and New Guinea.

3. Ichnanthus Beauv.

Ichnanthus Beauv., Ess. Agrost. 56. *pl. 12, fig. 1.* 1812.

Spikelets as in *Panicum,* but more or less laterally compressed, the glumes and sterile lemma strongly nerved; first glume from half to nearly as long as the spikelet; second glume and sterile lemma equal or subequal, the lemma enclosing a palea and sometimes a staminate flower; fertile lemma dorsally compressed, chartaceous-indurate, short-stipitate and bearing on either side membranous appendages adnate to the base of the lemma or these reduced or indicated by minute excavations only (our species has only excavations). Weak-stemmed, rather broad-leaved grasses with short-pediceled spikelets in open or somewhat contracted panicles.

Type species: *Ichnanthus panicoides* Beauv.

1. **Ichnanthus vicinus** (F. M. Bailey) Merr., Enum. Philip. Fl. Pl. 1: 70. 1922; Ohwi, Bot. Mag. (Tokyo) 56: 5. 1942.

Panicum vicinum F. M. Bailey, Syn. Queensl. Fl. Suppl. 3: 82. 1890. Type from Australia.

Panicum nitens Merr., (Philip.) Gov. Lab. Bur. Bull. 17: 8. 1904. (non Schum. 1901). Type from the Philippines.

Culms weak, decumbent at base and rooting at the nodes, the upright branches 15–50 cm. tall; sheaths usually slightly shorter than the internodes, glabrous or more or less pubescent, villous on the margins; ligule membranous-ciliate, about 1 mm. long; blades ovate to ovate-lanceolate, 3–8 cm. long, 1–2.5 cm. wide, subglabrous to somewhat stiff-puberulent; panicles terminal and axillary, open to somewhat contracted, as much as 15 cm. long, the branches slender, compound, scabrous; spikelets glabrous, or rarely more or less pilose, 3.5–5 mm. long, more or less laterally compressed, the glumes and sterile lemma strongly nerved; glumes unequal, 5-nerved, acuminate to short-aristate, scabrous on the keels at least toward

the tips; first glume about two-thirds as long as the spikelet and separated from the second by a distinct internode; second glume and sterile lemma equal or the lemma slightly shorter; sterile lemma 5-nerved, acute to acuminate, enclosing a palea and sometimes a staminate flower; fertile lemma chartaceous-indurate, 2–2.5 mm. long, obtuse, stipitate and bearing two scars above the base.

NORTHEAST NEW GUINEA: Morobe District: Salamaua, alt. about 100 m., *Clemens 4332* (A); alt. about 1000 m., *Clemens 41238* (US); Boana, alt. about 100 m., *Clemens 41808* (US). NETHERLANDS NEW GUINEA: Hollandia, alt. 50 m., *Brass 8909* (A, US) (abundant on shaded sandy banks in a moist ravine); 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13210* (A, US) (occasional on flooded rocky banks of river).

Southern Asia, East Indies, Philippines to New Guinea and Australia.

Very closely related to the American *Ichnanthus pallens* (Sw.) Munro ex. Benth. and perhaps should be included with that species. The spikelets of the Old World form are, in general, slightly larger and the glumes tend to be more aristate than in the American plants.

4. Echinochloa Beauv.

Echinochloa Beauv., Ess. Agrost. 53. *pl. 11, fig. 2.* 1812.

Spikelets more or less hispid, plano-convex, subsessile, in pairs or in irregular clusters along one side of the panicle branches; first glume about one-third to half the length of the spikelet, acute or mucronate; second glume and sterile lemma equal, the latter mucronate to long-awned, with a membranous palea and sometimes a staminate flower; fertile lemma indurate, slightly crested at the apex, smooth and shining, the margins inrolled, the tip of the palea usually free. Annual or perennial grasses with usually narrow panicles of several secund spikelike racemes.

TYPE SPECIES: *Echinochloa crusgalli* (L.) Beauv. (*Panicum crusgalli* L.).

KEY TO THE SPECIES

1. Ligule a dense row of hairs about 4 mm. long; sterile lemma enclosing a staminate floret; plants perennial.....3. *E. stagnina.*
1. Ligule wanting; sterile lemma empty, but with a membranous palea; plants annual.
   2. Spikelets about 2 mm. long, the awn of the sterile lemma reduced to a short point; racemes distant, 1–2 cm. long, the upper about as long as the lower.....1. *E. colonum.*
   2. Spikelets about 3 mm. long, the awn of the sterile lemma variable, but evident; racemes more or less approximate, usually more than 2 cm. long, the upper shorter than the lower.....2. *E. crusgalli.*

1. **Echinochloa colonum**[7] (L.) Link, Hort. Berol. 2: 209. 1833; Hitchc., Brittonia 2: 123. 1936; C. E. Hubb. and Vaughan, Grass. Maurit. and Rodriguez 69. *fig. 12.* 1940.

   Panicum colonum L., Syst. Nat. ed. 10. 2: 870. 1759; Trin., Sp. Gram. Ic. 2: *pl. 160.* 1829; K. Schum. and Lauterb., Fl. Deutsch. Schutzgeb. Südsee 178. 1901. Type from Jamaica.[8]

   Oplismenus colonus (L.) H.B.K., Nov. Gen. et Sp. 1: 108. 1815.

   Echinochloa crusgalli subsp. *colona* (L.) Honda, Bot. Mag. (Tokyo) 37: 122. 1923.

[7] For a discussion of the proper ending of the specific epithet, see Hitchc., Contr. U. S. Nat. Herb. 17: 256. 1913.

[8] See Hitchcock, Contr. U. S. Nat. Herb. 12: 119. 1908 and 22: 150. 1920.

Annual; culms glabrous, erect or decumbent, usually much branched at base, 20–80 cm. long; sheaths glabrous, shorter than the internodes, rather loose, somewhat keeled toward the summit; ligule wanting; blades rather lax, 6–15 cm. long, 3–8 mm. wide, glabrous to sparsely pubescent, the margins scabrous; panicle 5–15 cm. long, the axis and branches scabrous to puberulent; racemes simple, single or occasionally approximate, 1–2 cm. long; spikelets 2–3 mm. long, crowded, the glumes and sterile lemma glabrous to scabrous-puberulent, the nerves scabrous-hispid; first glume one-third to half as long as the spikelet, 3-nerved; second glume about equal to the sterile lemma, mucronate, 5-nerved; sterile lemma slightly exceeding the second glume, mucronate or awn-pointed, flattened on the back, enclosing a hyaline palea of equal length; fertile lemma rounded on the back, smooth and shining, obscurely 5-nerved, short-acuminate, the margins inrolled below, the apex of the palea not enclosed.

BRITISH NEW GUINEA: Central Division: Kanosia, *Carr 11022* (NY); Western Division: Strickland River, *W. Bauerlen 40* (US); Daru Island, *Brass 6044, 6300* (A, US). NORTHEAST NEW GUINEA: Morobe District: Markham Valley, Kajabit Mission, *Clemens 10476-S* (US); 4 miles south of Langemak Bay, *Sawyer 32, 52* (A).

Pantropic weed.

2. **Echinochloa crusgalli** (L.) Beauv., Ess. Agrost. 53, 161, 169. 1812; Chase, Jour. Arnold Arb. 24: 88. 1943.

Panicum crusgalli L., Sp. Pl. 56. 1753; Trin., Sp. Gram. Ic. 2: *pl. 161.* 1829; F. Muell., Pap. Pl. 2: 35. 1886. Type from Europe.

Annual; culms caespitose, erect or decumbent at base, 30–100 cm. tall; sheaths glabrous, rather loose, somewhat keeled, especially toward the summit; ligule wanting; blades linear, 10–40 cm. long, 5–15 mm. wide, the margins and upper surface usually scabrous; panicles 10–20 cm. long, erect or somewhat nodding, the axis scabrous and often somewhat papillose-hispid, the hairs often rather long; racemes appressed to spreading, 2–7 cm. long, simple or branching below, gradually shorter and more or less approximate upwards, the rachis scabrous and often papillose-hispid; spikelets about 3 mm. long, hispid on the nerves, the internerves scabrous to hispidulous; first glume one-third to half as long as the spikelet, acute; second glume about equaling the sterile lemma, acuminate to awn-pointed; sterile lemma mucronate-tipped or with an awn as much as 4 cm. long.

BRITISH NEW GUINEA: Western Division: Mainland opposite Daru Island, *Brass 6060* (GH, US) (common in outer shallows of a large coastal swamp); Lower Fly River, *Brass 8280* (A, US) (common on sandy foreshores); near the Dutch Boundary, *MacGregor 14* (US). NORTHEAST NEW GUINEA: Morobe District: *Clemens 4775* (A); Ogeramnang, alt. about 1700 m., *Clemens 5476* (A); near Kajabit Mission, *Clemens 10650* (US). NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11793, 11803* (A, US) (common in ditches); Rouffaer River, alt. 65 to 175 m., *Docters van Leeuwen 9709, 10167* (NY).

Widely distributed in the warmer regions of both hemispheres.

This species is extremely variable, and numerous subspecies, varieties, and forms have been recognized. The spikelets vary slightly in size, in the length of awn on the sterile lemma, and the degree of hispidness, the hairs being sometimes tuberculate-based. The cited specimens represent both awned and nearly awnless forms, but are similar in other respects. The spikelets are less hispid than those of many European and American

plants. *Brass 6060* was cited as *Echinochloa crus-pavonis* (H. B. K.) Schult. by Hitchcock (35, p. 123).

3. **Echinochloa stagnina** (Retz.) Beauv., Ess. Agrost. 53, 161, 171. 1812; Chase, Jour. Arnold Arb. 20: 312. 1939.
Panicum stagninum Retz., Obs. Bot. 5: 17. 1789. Type from Eastern India.

Perennial usually growing in deep water; culms rather succulent, stout, about 1 cm. in diameter, 2–? meters long, rooting from the nodes below the water level; sheaths rather loose, glabrous or sometimes ciliate on the margins; ligule a dense row of soft tawny hairs about 4 mm. long; blades 30–50 cm. long, 1–3 cm. wide, glabrous to scaberulous on both surfaces, the margins scabrous; panicle 20–50 cm. long, the axis and branches scabrous, the latter stiff-pilose at base, often somewhat branched, as much as 15 cm. long; spikelets about 4 mm. long, excluding the awns, crowded, short-pediceled, scabrous, the nerves hispid; first glume one-third to half as long as the spikelet, acute, often ciliate; second glume about equaling the sterile lemma, long-acuminate or short awn-pointed, the margins sometimes ciliate; sterile lemma flattened on the back, enclosing a palea and a staminate flower, awned from the tip, the awn 2 mm. or more long; fertile lemma 3.5–4 mm. long, plano-convex, smooth and shining, acuminate, the margins inrolled below, the tip of the palea not enclosed.

BRITISH NEW GUINEA: Western Division: Fly River, about 30 miles below Everill Junction, *Brass 6585* (A, US). NORTHEAST NEW GUINEA: Sepik River, Nyamangai, *Herre 319* (NY). NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, alt. 50 m., *Brass 13785* (A, US).

India to the East Indies, Philippines and New Guinea. Also in tropical Africa. Coarse robust perennials of marshes and river banks, sometimes growing in water more than 2 meters deep. Often forming pure stands locally.

The description was drawn from New Guinea specimens which are, perhaps, more robust than usual. Small specimens may be distinguished from *E. crusgalli* by the larger spikelets and especially by the ligule; the ligule in *E. crusgalli* is wanting.

5. Oplismenus Beauv.

Oplismenus Beauv., Fl. Owar. 2: 14. *pl. 68, fig. 1.* 1809.
Orthopogon R. Br., Prodr. Fl. Nov. Holl. 1: 194. 1819.

Spikelets terete or somewhat laterally compressed, subsessile, solitary or in pairs, in two rows, crowded or approximate on one side of a narrow scabrous or hairy rachis, the back of the fertile lemma turned toward it; glumes subequal, awned, the awn of the first glume considerably longer than that of the second, often as long as or exceeding the length of the spikelet; sterile lemma empty or rarely enclosing a staminate flower, longer than the glumes and fertile floret, awnless or short-awned, the awn rarely as much as 2 mm. long; sterile palea absent or when present narrow, hyaline, ciliate at apex, fertile lemma chartaceous-indurate, pale, smooth and shining, acute, usually minutely crested, sometimes short-awned, the awn as much as 0.6 mm. long, rarely longer. Freely branching creeping annuals or perennials of shady habitats with flat lanceolate blades and inflorescences of few to several alternate spikelike racemes racemose on the main axis, the racemes sometimes very short and the spikelets crowded

and appearing fascicled, or the racemes almost totally absent and the spikelets solitary or in twos or threes along the axis.

TYPE SPECIES: *Oplismenus africanus* Beauv. = *O. hirtellus* (L.) Beauv.

KEY TO THE SPECIES

1. Racemes 1.5–6 cm. long; sterile lemma awnless or nearly so.....1. *O. compositus.*
1. Racemes 0.2–1 cm. long; sterile lemma awned, the awn 0.5–1 mm. long.....2. *O. hirtellus.*

1. **Oplismenus compositus** (L.) Beauv., Ess. Agrost. 54, 168. 1812; K. Schum., Bot. Jahrb. 9: 196. 1887; Pilger, Nat. Pflanzenfam. ed. 2. 14e: 48. *fig. 25.* 1940.
Panicum compositum L., Sp. Pl. 57. 1753; F. Muell., Pap. Pl. 1: 31, 74. 1876. Type from Ceylon.

Culms up to 1 meter long, decumbent at base and rooting from the lower nodes; sheaths shorter than the internodes, glabrous to rather densely papillose-pilose, the margins ciliate; ligule hyaline, truncate, ciliate above; blades lanceolate to ovate-lanceolate, 5–15 cm. long, 1–2 cm. wide, rarely wider, subglabrous to pilose, usually more densely hairy below, the margins often undulate; racemes usually densely flowered, 1.5–6 cm. long or longer; spikelets glabrous to pilose, terete or nearly so; glumes subequal, 1.5–3 mm. long excluding the awns; awn of the first glume 2–8 mm. long, that of the second 0.3–1.5 mm.; sterile lemma exceeding the glumes, 3–4 mm. long, awnless or nearly so, usually enclosing a narrow hyaline palea about equal to the lemma, and rarely also a staminate flower; fertile lemma smooth and shining, 2.5–3 mm. long, the apex with a minute laterally compressed crest which may appear as a minute mucro in dorsal or ventral view especially when immature.

BRITISH NEW GUINEA: Northern Division: Soputa, *DeKalb Russell Jr.* in 1943 (US). NORTHEAST NEW GUINEA: Morobe District: Markham Valley, Kajabit, *Clemens 10568* (US); Finschhafen, *Weinland 279* (US); without precise locality, *Rodatz & Klink 69* (US). NEW BRITAIN: Talasea, near Bitokara Mission, *Burcham 137* (US).

Widely distributed in the tropics of the Old World.

2. **Oplismenus hirtellus** (L.) Beauv., Ess. Agrost. 54, 168. 1812; Stapf in Prain, Fl. Trop. Afr. 9: 631. 1920; Hitchc., Proc. Linn. Soc. N. S. Wales 54: 146. 1929.
Panicum hirtellum L., Syst. Nat. ed. 10. 2: 870. 1759; Sp. Pl. ed. 2. 83. 1763. Type from Jamaica.
Oplismenus africanus Beauv., Fl. Owar. 2: 15. *pl. 68, fig. 1.* 1809. Type from West Africa.
Oplismenus aristulatus Burcham, Contr. U. S. Nat. Herb. 30: 419. *fig. 1.* 1948. Type from New Britain.

Slender creeping branching perennial, the ascending flowering culms 20–40 cm. tall; sheaths mostly shorter than the internodes, glabrous to papillose-pilose, the margins and collar densely pubescent-ciliate; ligule membranous, truncate, erose, ciliate, the hairs often equaling the membrane; blades lanceolate, narrowed at the base, 3–10 cm. long, 5–10 (rarely to 16) mm. wide, the margins usually undulate, glabrous or scabrous to variously pubescent, usually more densely so on the lower surface, the hairs sometimes papillose-based; racemes distant, 2–10 mm. long (in our specimens), densely flowered, the spikelets often appearing fascicled, the narrow angled rachis scabrous to long stiff pilose; spikelets terete or somewhat laterally compressed, 3–4.5 mm. long excluding the

awns, sparsely to densely pubescent, the hairs sometimes papillose-based; glumes subequal, 2–3 mm. long; first glume awned from the tip, the awn 3–8 mm. long; second glume awned from the apex or slightly below it, the awn 0.5–3.5 mm. long, slightly more slender than that of the first glume; sterile lemma slightly exceeding the glumes, pubescent on the upper half especially toward the margins, the apex bearing a short awn 0.5–1 mm. long; sterile palea, when present, narrow, hyaline, 1.5–3 mm. long, the apex ciliate; fertile lemma pale, 2–3 mm. long, smooth and shining, faintly nerved, the apex with a minute laterally compressed crest which is sometimes prolonged into a mucro as much as 0.6 mm. long.

BRITISH NEW GUINEA: Central Division: Rona, Laloki River, alt. 450 m., *Brass 3647* (A, US) (common rain forest floor plant); Eastern Division: Mori River, *Brass 1534* (GH, US) (on forest paths); Western Division: Lake Daviumbu, Middle Fly River, *Brass 7483* (A, US) (abundant in light forest shade). NORTHEAST NEW GUINEA: Morobe District: Sarawaket, *Clemens 5756* (A); Dreger Harbor, near Finschhafen, *Reeder 868* (A, US) (in shade of bamboos). NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1600 m., *Brass 12364* (A, US) (rain-forest, one small clump in the stony bed of a stream); 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13719* (A, US) (on open sandy banks of a rain-forest stream); Waren, *Kanehira and Hatusima 13160* (A). NEW BRITAIN: Talasea, Bitokara Mission, *Burcham 138* (US) (under rain-forest, along trail).

Widely distributed in the tropics of both hemispheres.

A wide-ranging polymorphic species which is difficult to characterize. Perhaps the best character for recognizing this species is the short-awned sterile lemma of the spikelets which are arranged in short racemes racemose along a main axis, the rachis varying from 2 mm. to a centimeter or more in length, but rather uniform on one plant. Specimens with rather long racemes may be distinguished from *Oplismenus compositus* with a fair degree of accuracy, since that species has an awnless sterile lemma. In other respects the spikelets are very similar. Some of the New Guinea plants look very much like *O. setarius* (Lam.) Roem. and Schult. and have been so reported by the early German workers. Typical *O. setarius* from the New World, however, usually has smaller leaves and slightly smaller spikelets, but the reasons for considering it as distinct from *O. hirtellus* are not altogether convincing, as there seem to be numerous intergrades. Stapf (in Prain, Fl. Trop. Afr. 9: 632. 1920) does not consider it distinct. Some of the cited specimens have been referred to *O. undulatifolius* (Ard.) Roem. and Schult. (see Hitchc., Brittonia 2: 123. 1936) and to *O. undulatifolius* var. *imbecillis* (R. Br.) Hack. (see Ohwi, Bot. Mag. (Tokyo) 56: 7. 1942). Typical *O. undulatifolius*, however, has characteristically spreading-pilose sheaths, and the inflorescence consists of rather long racemes below, which become progressively shorter upward until the spikelets are borne singly or in only twos or threes on the upper part of the axis. *Oplismenus undulatifolius* var. *imbecillis* (based on *Orthopogon imbecillis* R. Br. from Australia) has very much reduced racemes, the spikelets being borne singly or in small groups on the main axis, the sterile lemma is awnless, and the awn of the second glume is much reduced.

One of the cited specimens (*Burcham 138*) has been designated the type of a new species (*Oplismenus aristulatus* Burcham), based primarily on the mucronate character of the fertile lemma. The spikelets are densely pubescent, borne in short racemes, the rachis of which is 2–6 mm. long, and the blades are up to 10 cm. long and 15 mm. wide. The validity of this species seems doubtful, however, when it is seen that the fertile lemmas are crested throughout the genus and the crest may extend as a mucro or even a short awn in vastly different appearing plants. Some Philippine specimens (see *Philip. Bur. Sci. No. 30286*, collected by M. Ramos in 1917, and *Elmer 17105*) have blades only 2–5 cm. long and 3–7 mm. wide and nearly glabrous spikelets, but the fertile lemma has an awn fully as long as the Burcham specimen. On the other hand a Japanese specimen (Nat. Herb. No. 1130009) which resembles in many respects the figure accompanying the original description of *O. undulatifolius*, has blades as much as 8 cm. long and 2 cm. wide, and lower racemes up to 10 mm. long, but the fertile lemma bears an awn about 0.5 mm. long. A specimen from Formosa (*Beattie and Kurihara 10393*) has the long racemes (up to 8 cm. long) of *O. compositus* but the fertile lemma bears an awn 0.2–1 mm. long. Other cases could be cited. Another interesting specimen (*Millspaugh 2679*) from Japan may help to evaluate the importance of the awned fertile lemma as a specific character. In this specimen the same raceme was found to have some of the lemmas completely awnless, while others had awns fully 1 mm. long. In view of the above evidence, it seems undesirable to consider the mucronate to short-awned fertile lemma as at all unique, but rather as a potentiality which may appear anywhere in the genus.

6. Sacciolepis Nash

Sacciolepis Nash in Britton, Man. 89. 1901.

Spikelets oblong-conic, more or less oblique in profile, somewhat laterally compressed; first glume much shorter than the spikelet; second glume more or less inflated-saccate or gibbous on the back, strongly many-nerved; sterile lemma equaling the second glume but fewer-nerved and with a reduced hyaline palea; fertile lemma dorsally compressed, stipitate, elliptic, chartaceous-indurate, the margins inrolled. Plants of damp habitats with dense contracted, spikelike panicles.

TYPE SPECIES: *Sacciolepis striata* (L.) Nash (*Holcus striatus* L., *Panicum gibbum* Ell.).

KEY TO THE SPECIES

1. Spikelets 1.5–2 mm. long, only slightly gibbous; fertile floret nearly as long as the spikelet.....1. *S. myosuroides.*
1. Spikelets 2–3.5 mm. long, strongly gibbous; fertile floret only about half as long as the spikelet.....2. *S. indica.*

1. **Sacciolepis myosuroides** (R. Br.) Chase ex A. Camus in Lecomte, Fl. Gén. Indo-Chine 460. 1922; Blatter and McCann, Imp. Council Agric. Res. Sci. Monogr. 5: *pl. 107*. 1935; Hitchc., Brittonia 2: 123. 1936.
   Panicum myosuroides R. Br., Prodr. Fl. Nov. Holl. 1: 189. 1810. Type from Australia.

Panicum phleiforme Presl, Rel. Haenk. 1: 310. 1830; Hack., Bot. Jahrb. 13: 258. 1890; Scribn., Missouri Bot. Gard. Rep. 10: 47. *pl. 21.* 1899. Type from the Philippines.

Hymenachne myosuroides (R. Br.) Balansa, Jour. de Bot. 4: 143. 1890.

Culms erect or somewhat decumbent and rooting at the lower nodes, the upright or ascending portion 15–110 cm. tall; sheaths glabrous, mostly shorter than the internodes, subcompressed with scarious margins; ligule membranous, ciliate, about 1 mm. long; blades flat to subinvolute, as much as 20 cm. long, 2–4 mm. wide, glabrous or somewhat scabrous on the margins; panicle densely flowered, much contracted, spikelike, 5–20 (rarely 30) cm. long; spikelets obtuse to subacute, glabrous or sparsely pubescent toward the tip, 1.5–2 mm. long; first glume about one-third to half as long as the sterile lemma, only very slightly gibbous on the back, 7–9-nerved; sterile lemma 7-nerved, similar to the second glume but with a reduced hyaline palea; fertile floret nearly as long as the spikelet.

BRITISH NEW GUINEA: Western Division: Dagwa, Oriomo River, alt. 45 m., *Brass 6029* (A, US) (scattered in shallows of a lagoon on savannah); Middle Fly River, Lake Daviumbu, *Brass 7854* (A, US) (growing in shallow water on wet grass plains). NORTHEAST NEW GUINEA: Morobe District: Boana, alt. 800–1300 m., *Clemens 41356a* (US).

Tropical Africa and Asia to Australia and Polynesia.

Related to *Sacciolepis indica,* but may be distinguished by its smaller obtuse to subacute spikelets with the second glume only slightly gibbous on the back. The spikelets of *S. indica* are acuminate and strongly gibbous.

2. **Sacciolepis indica** (L.) Chase, Proc. Biol. Soc. Wash. 21: 8. 1908; Hitchc., Brittonia 2: 122. 1936.

Aira spicata L., Sp. Pl. 63. 1753 (non op. cit. 64); *Aira indica* L., Sp. Pl. (in errata). 1753. Type from India.

Panicum indicum L., Mant. 2: 184. 1771; Trin., Sp. Gram. Ic. 2: *pl. 197.* 1829; Pilger, Bot. Jahrb. 52: 171. 1914. Type from India.

Panicum contractum Wight and Arn., Linnaea 10: Litt. 117. 1836. Type from India.

Neurachne Peekelii Lauterb., Bot. Jahrb. 45: 356. 1911. Type from New Ireland.[9]

Sacciolepis contracta (Wight and Arn.) Hitchc., Mem. Bishop Mus. 8: 199. *fig. 90.* 1922; Chase, Jour. Arnold Arb. 24: 87. 1943.

Culms erect or creeping, often densely tufted, simple or branching, 10–150 (commonly 30–60) cm. tall; sheaths shorter than the internodes, somewhat keeled toward the summit, glabrous to more or less densely papillose-pubescent; ligule membranous, about 0.5 mm. long; blades flat to loosely involute, as much as 25 cm. long, 2–5 (rarely up to 8) mm. wide, glabrous to more or less pubescent; panicle long-exserted, 1–15 cm. long, the axis and terete discoid-tipped pedicels glabrous; spikelets 2–3.5 mm. long, glabrous to rather densely papillose-hispid (usually with at least a few hairs near the tip); first glume one-third to two-thirds as long as the spikelet, 3–7-nerved, the margins scarious; second glume strongly gibbous on the back, about 9–11-nerved; sterile lemma equal to the second glume and similar to it but not gibbous and with a poorly developed hyaline palea; fertile lemma about half as long as the spikelet.

[9] The type was not seen, but Pilger (Bot. Jahrb. 52: 171. 1914) says that it represents *Panicum indicum* L. [*Sacciolepis indica* (L.) Chase].

British New Guinea: Central Division: Urunu, Vanapa Valley, alt. 1900 m., *Brass 4789* (GH, US) (a common erect grass on open grassland); Mafulu, alt. 1250 m., *Brass 5483* (GH, US) (rare on roadsides and in grasslands); Western Division: Wuroi, Oriomo River, *Brass 5744* (US), *5827* (GH, US) (rare on damp soil on savannah); Palmer River, 1 mile above junction Black River, alt. about 100 m., *Brass 6961* (A, US) (on gravel bar); Lake Daviumbu, Middle Fly River, *Brass 7519* (A, US) (tufted on patches of hard pan in savannahs), *Brass 7880* (A, US) (occasional on hummocks of wet grass plains); Gaima, Lower Fly River, *Brass 8351* (A, US) (sporadic in open savannah forest); Tarara, Wassi Kussa River, *Brass 8713, 8776* (A, US) (savannah forest ridges); Northern Division: About 3 miles south of Dobodura, *Reeder 823, 825, 847* (A, US) (low, wet ground). Northeast New Guinea: Morobe District: Yunzaing, alt. about 1000 m., *Clemens 4053* (US); Sattelberg, alt. 100 m., *Clemens 4315* (A); Wantoat, elev. 1000–2000 m., *Clemens 10955 bis* (US); alt. 80–1200 m., *Clemens 41356a* (US); four miles south of Langemak Bay (near Finschhafen), *Sawyer 143* (A). Netherlands New Guinea: 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass 10736* (A, US) (several suberect tufts about 80 cm. tall on a native clearing in the forest); 18 km. northeast of Lake Habbema, Bele River, alt. 2200 m., *Brass 11524* (A, US) (plentiful on old garden lands); Balim River, alt. 1600 m., *Brass 11824* (A, US) (plentiful on sandy, long deforested slopes); Nassau Region, Explorat Biv., alt. 1200 m., *Docters van Leeuwen 10809* (GH); Utakwa Expedition to Mt. Carstensz, Camp VI, alt. about 1000 m., *Kloss* in 1913 (US); Angi, Arfak Mountains, alt. 1900 m., *Kanehira & Hatusima 13826* (A).

The type specimen in the Linnaean Herbarium is a delicate creeping or spreading plant with many short spikes (about 1 cm. long) of only a few spikelets.[10] Among the specimens cited above, *Brass 5824* is most nearly like the type. The species is an extremely variable one, however, and all variations may be seen from small glabrous plants (only about 10 cm. tall) to tall pubescent plants (150 cm. or more in height). The spikelets themselves vary from glabrous to densely papillose-pubescent, but all show the characteristic form and structure. There seems to be no correlation between the pubescence on the spikelets and that on the rest of the plant. While *Reeder 825* and *847* (the tallest and most hairy of the specimens cited) appear at first to be distinct, critical study shows that there is no reliable character by which they may be separated. In view of the numerous intergrades between these tall hairy plants and the glabrous ones, it seems advisable to consider all the above-cited specimens as conspecific and members of an extremely polymorphic species (*S. indica*) in which even varieties can be separated in only the most arbitrary manner.

7. **Pseudechinolaena** (Hook. f.) Stapf

Pseudechinolaena (Hook. f.) Stapf in Prain, Fl. Trop. Afr. 9: 494. 1919.
Panicum sect. *Pseudechinolaena* Hook. f., Fl. Brit. Ind. 7: 28, 58. 1896.

Spikelets obliquely ovoid, laterally compressed and usually conspicuously gaping, in pairs or more often solitary on a narrow rachis of spikelike, racemosely arranged racemes, the back of the fertile lemma turned away from the rachis; glumes about equal or the first somewhat shorter;

[10] From data recorded by A. S. Hitchcock after examination of the type in 1907. Prof. Hitchcock's notebooks are preserved in the Hitchcock-Chase Agrostological Library at the Smithsonian Institution.

first glume 3-nerved, flat, smooth or scabrous along the midnerve; second glume 7-nerved, gibbous and more or less uncinate-spiny at maturity; sterile lemma as long as the spikelet, obscurely nerved, smooth or minutely tuberculate under a lens, enclosing a palea and sometimes a staminate flower; fertile lemma somewhat laterally compressed, indurate, smooth and shining, the margins clasping the palea but not inrolled. Weak-stemmed annuals with broad thin leaves and short few-flowered panicles.

TYPE AND ONLY SPECIES: *Pseudechinolaena polystachya* (H.B.K.) Stapf (*Echinolaena polystachya* H.B.K.).

1. **Pseudechinolaena polystachya** (H.B.K.) Stapf in Prain, Fl. Trop. Afr. 9: 495. 1919, Hook. Ic. 31: *pl. 3094*. 1922.

Echinolaena polystachya H.B.K., Nov. Gen. et Sp. 1: 119. 1815. Type from Colombia.

Panicum uncinatum Raddi, Agrost. Bras. 41. 1823. Type from Brazil.

Culms creeping and rooting at base, 40–60 cm. long, prominently striate and sparsely pubescent; sheaths shorter than the internodes, more or less pubescent, ciliate along the margins; ligule membranous, 1–2 mm. long, often ciliate; blades thin, ovate-lanceolate, 3–6 cm. long, 1–1.5 cm. wide, sparsely appressed-pubescent, the hairs stiff; racemes few to several, erect or ascending, loosely flowered, racemose along a main axis, the rachis narrow, scabrous; spikelets about 5 mm. long.

NORTHEAST NEW GUINEA: Morobe District: Sattelberg, alt. 1000 m., *Clemens 662* (A, US); near Kajabit Mission, alt. about 300 m., *Clemens 40800* (US); Boana, alt. about 800 m., *Clemens 41591* (US).

Shady habitats in the tropics of both hemispheres.

8. Cyrtococcum Stapf

Cyrtococcum Stapf in Prain, Fl. Trop. Afr. 9: 745. 1920.

Spikelets laterally compressed, obliquely obovate, in open or somewhat contracted panicles; glumes unequal, membranous, 3-nerved, the first smaller, the second cymbiform and nearly as long as the spikelet; sterile lemma 5-nerved, equaling the spikelet and with a reduced palea (this sometimes wanting); fertile lemma indurate, strongly gibbous on the back and with a small crest near the tip, the margins inrolled and clasping a narrow, convex palea. Annual or perennial grasses of shady habitats, with thin, lanceolate blades and creeping culms.

TYPE SPECIES: *Cyrtococcum setigerum* (Beauv.) Stapf (*Panicum setigerum* Beauv.).

KEY TO THE SPECIES

1. Panicles contracted, the branches rather stout, angled.
   2. Spikelets glabrous; plants 20–40 cm. tall ..... 1. *C. oxyphyllum*.
   2. Spikelets hispid; plants low, 6–15 cm. tall ..... 2. *C. trigonum*.
1. Panicles diffuse, the branches capillary, terete ..... 3. *C. patens*.

1. **Cyrtococcum oxyphyllum** (Hochst. ex Steud.) Stapf, Hook. Ic. 31: sub *pl. 3096*. 1922.

Panicum oxyphyllum Hochst. ex Steud., Syn. Pl. Glum. 1: 65. 1854; Hitchc., Brittonia 2: 122. 1936. Type from India.

Panicum pilipes Nees and Arn. ex Buse in Miq., Pl. Jungh. 3: 376. 1854; K. Schum., Notizbl. Bot. Gart. Berlin 2: 93. 1898. Type from Java.

Panicum hermaphroditum Steud., Syn. Pl. Glum. 1: 67. 1854; Hack., Bot. Jahrb. 13: 259. 1890. Type from the Philippines.

Cyrtococcum pilipes (Nees and Arn. ex Buse) A. Camus, Bull. Mus. Hist. Nat. (Paris) 27: 118. 1921; Blatter and McCann, Imp. Council Agric. Res. Sci. Monogr. 5: *pl. 110*. 1935.

Culms glabrous, creeping, often somewhat flattened, the ascending flowering branches 20–40 cm. tall; sheaths shorter than the internodes, pubescent, ciliate on the margins, keeled, especially toward the summit; ligule membranous, about 1 mm. long; blades 3–10 cm. long, 5–10 mm. wide, pubescent, more densely so beneath, the upper surface often almost glabrous; panicle contracted, densely flowered, 4–10 cm. long, shortly exserted, the branches rather stout; spikelets about 1.8 mm. long, glabrous, the base subtended by a few fine hairs; fertile lemma short-stalked, strongly gibbous on the back, smooth and shining, but under a lens minutely longitudinally striate.

BRITISH NEW GUINEA: Eastern Division: Aisa River, *Brass 1423* (GH, US) (on shady forest paths); Central Division: Dieni, Ononge Road, alt. 500 m., *Brass 3820* (GH, US) (common on roadside); Kabuna, alt. 100 m., *Brass 5594* (GH, US) (plentiful on pathways in forest); Kanosia, *Carr 11171* (US) (clearing in forest), *Carr 11786* (US) (swampy land under *Hevea*); Brown River, *Carr 12941* (US) (river bank); Northern Division: About 2 miles north of Big Embi Lake, *Reeder 820* (A, US) (in partial shade on creek bank); Without precise locality: *Chalmers 59* (US). NORTHEAST NEW GUINEA: Morobe District: Finschhafen, *Weinland 278* (US). NEW BRITAIN: Near Bitokara Mission, Talasso, *Burcham 139* (US) (under rain-forest). SOLOMON ISLANDS: Bougainville: *Kajewski 2139* (GH); San Cristoval: *Brass 2732, 2857A* (GH).

Indo-Malayan region to New Guinea.

2. **Cyrtococcum trigonum** (Retz.) A. Camus, Bull. Mus. Hist. Nat. (Paris) 27: 118. 1921.

Panicum trigonum Retz., Obs. Bot. 3: 9. 1783; Hack., Bot. Jahrb. 13: 259. 1890. Type probably from India.

Culms slender, glabrous, creeping, the ascending flowering branches 5–15 cm. long; sheaths equaling or longer than the internodes (sometimes slightly shorter), glabrous except for the long-ciliate margins; ligule membranous, decurrent, 0.3–0.5 mm. long; blades 1–4.5 cm. (mostly 2–3 cm.) long, 2–5 mm. wide, subglabrous to sparingly papillose-pubescent, the hairs more numerous on the upper surface; panicle very contracted, 1–3 cm. long, the rachis and branches rather stout and angled, the lowermost branches not more than 1 cm. long; spikelets 1.6–2 mm. long, hispid or tuberculate-hispid, the first glume often nearly glabrous, the hairs confined to the second glume and sterile lemma.

BRITISH NEW GUINEA: Central Division: Koitaki, *Carr 11964* (US).

India to the Philippines, New Guinea and Samoa. Introduced into the West Indies.

3. **Cyrtococcum patens** (L.) A. Camus, Bull. Mus. Hist. Nat. (Paris) 27: 118. 1921; Ohwi, Bot. Mag. (Tokyo) 56: 6. 1942.

Panicum patens L., Sp. Pl. 58. 1753; K. Schum. and Lauterb., Fl. Deutsch. Schutzgeb. Südsee 178. 1901. Type from India.

Panicum radicans Retz., Obs. Bot. 4: 18. 1786. Type from China.

Panicum accrescens Trin., Sp. Gram. Ic. 1: *pl. 88*. 1827. Type from India.

Panicum carinatum Presl, Rel. Haenk. 1: 309. 1830; Guppy, Solomon Islands 304. 1887; K. Schum., Notizbl. Bot. Gart. Berlin 1: 206. 1896; Scribn., Missouri Bot. Gard. Rep. 10: 46. *pl. 17*. 1899. Type from the Philippines.

Paspalum carinatum (Presl) K. Schum. and Hollr., Fl. Kais. Wilhelmsland 21. 1889. Error for *Panicum carinatum* Presl.

Culms glabrous, slender, creeping, the ascending flowering branches as much as 60 cm. tall; sheaths mostly shorter than the internodes, papillose-pilose, the margins ciliate; ligule membranous, about 1 mm. long; blades subglabrous to more or less densely appressed-pubescent, often papillose-pilose toward the base, 5–15 cm. long, 6–15 mm. wide; panicle diffuse, as much as 30 cm. long, the capillary branches and branchlets smooth, spikelet-bearing toward their ends; spikelets about 1.5 mm. long, purplish, glabrous or minutely hispidulous, especially toward the tips of the glumes and sterile lemma; fertile lemma indurate, minutely longitudinally striate.

BRITISH NEW GUINEA: Central Division: Kubuna, alt. 100 m., *Brass 5617* (A, US) (plentiful in native gardens); Western Division: Daru Island, *Brass 6295* (A, US) (massed under shade of mango trees in native gardens); Middle Fly River, Lake Daviumbu, *Brass 7773, 7889* (A, US) (common weed in rain-forest clearings and in native villages); Northern Division: About 9 miles northwest of Oro Bay, *Reeder 824* (A, US) (in sandy soil of recent borrow pit); Goodenough Island: Two miles west of Haiwali Village, *Burcham 135* (US) (scanty soil among boulders in dense secondary growth near native village). NORTHEAST NEW GUINEA: Morobe District: Wantoat, *Clemens 11272* (US); *Weinland 276* (US). SOLOMON ISLANDS: Bougainville: *Kajewski 2253* (GH).

Indo-Malayan region to New Guinea and Polynesia.

3a. **Cyrtococcum patens** (L.) A. Camus var. **Warburgii** (Mez) comb. nov.

Panicum Warburgii Mez in Perkins, Fragm. Fl. Philip. 143. 1904. Type from the Philippines.

Panicum patens var. *parvulum* Warb. ex Mez, *loc. cit.* (as synonym of *P. Warburgii*).

Panicum patens L. var. *Warburgii* (Mez) Hack. ex Merr., Philip. Jour. Sci. 1: Suppl. 362. 1906 (as synonym of *P. Warburgii*).

Cyrtococcum Warburgii (Mez) Stapf, Hook. Ic. 31: sub *pl. 3096*. 1922.

Much smaller than the species; blades 1–5 cm. long, 2–4 mm. wide; panicle 5–8 cm. long, often reduced to only a few branches; spikelets borne on terete capillary branches seemingly identical with those of *C. patens*. Perhaps it represents only a depauperate form of that species.

BRITISH NEW GUINEA: Central Division: Lolorua, *Carr 11503* (NY) (swampy land under *Hevea*).

Philippines and New Guinea.

9. **Cleistochloa** C. E. Hubb.

Cleistochloa C. E. Hubb., Hook. Ic. 33: *pl. 3209*. 1933.

Spikelets dorsally compressed, dimorphic, the back of the fertile lemma turned away from the axis; cleistogamous spikelets solitary, abundant in the axils of the sheaths, freely disarticulating from the pedicels when mature; chasmogamous spikelets borne in short, terminal, spikelike racemes; glumes unequal, the first small, hyaline, nerveless, the second nearly as long as the spikelet; sterile lemma about equaling the second glume and similar to it in the chasmogamous spikelets — in the cleistogamous spikelets much thickened and indurate on the back and with two prominent grooves, beaked, and as long as the fertile lemma which it nearly encloses; fertile lemma punctate-rugose in both kinds of spikelets, the margins thin, not inrolled. Perennial branching grasses with slender rigid culms, rigid blades, ciliate ligules, and short spikelike racemes.

Cleistogamous spikelets seem to be produced continually throughout the year while the terminal racemes appear only at certain seasons.

TYPE SPECIES: *Cleistochloa subjuncea* (Domin) C. E. Hubb. (*Panicum subjunceum* Domin, non Ekman).

1. **Cleistochloa Sclerachne** (F. M. Bailey) C. E. Hubb., Hook. Ic. 33: sub *pl. 3209*. 1933.

Chionachne Sclerachne F. M. Bailey, Queensl. Dept. Agr. Bull. 7 (Bot. Bull. 2): 21. 1891. Type from Australia.

Polytoca Sclerachne (F. M. Bailey) F. M. Bailey, Queensl. Fl. 6: 1849. 1902.

Perennial; culms tufted from a woody base, glabrous, rigid, branching, some of them weak and straggling, as much as 130 cm. long; sheaths much shorter than the internodes, glabrous or sparsely papillose-pilose, the hairs when present as much as 5 mm. long, ciliate on the margins, the hairs often much longer toward the ligule; ligule a row of stiff hairs about 0.5 mm. long; blades freely disarticulating from the sheaths, rigid, flat to subinvolute, 3–7 cm. long, 1.5–3.5 mm. wide, glabrous or minutely pubescent, often with a few long hairs near the base, the margins scabrous; chasmogamous spikelets about 5 mm. long, glabrous except for short cilia at the tip of the second glume and lemmas; first glume bifid, nerveless, about 0.5 mm. long; second glume slightly shorter than the spikelet, 5-nerved, the apex obtuse; sterile lemma as long as the spikelet, 7–9-nerved, obtuse; fertile lemma punctate-rugose; cleistogamous spikelets 5.5–8 mm. long, glabrous and shining except for a few minute cilia at the tip; first glume nerveless, reduced to an obscure rim at the base of the spikelet; second glume about one-sixth shorter than the spikelet, obtuse to apiculate, 5–7-nerved; sterile lemma indurate, prominently beaked, nearly as long as the fertile lemma which it almost completely encloses; fertile lemma punctate-rugose, chartaceous-indurate, the long beak usually extending slightly as a hard point through the overlapping margins of the tip of the sterile lemma.

BRITISH NEW GUINEA: Western Division: Tarara, Wassi Kussa River, *Brass 8735* (A, US) (on raw clay soils).

Australia and New Guinea.

Closely related to *Cleistochloa subjuncea* (Domin) C. E. Hubb., but that species has truncate or emarginate second glume and sterile lemma in the chasmogamous spikelets and trunctate second glume in the cleistogamous spikelets. The cited specimen has only one chasmogamous spikelet which is glabrous rather than pubescent. In all other respects it agrees well with the emended description by Hubbard (loc. cit.) and compares favorably with a topotype in the U. S. National Herbarium. This specimen was referred to *C. subjuncea* by Chase (17, p. 312).

10. **Alloteropsis** Presl

Alloteropsis Presl, Rel. Haenk. 1: 343. *pl. 47*. 1830.

Coridochloa Nees, Edinb. New Phil. Jour. 15: 381. 1833.

Spikelets ovate-lanceolate, dorsally compressed, in pairs or clusters along the narrow trigonous rachis, the back of the fertile lemma turned toward it; glumes membranous, unequal, the first smaller, 3-nerved and often with a short awn or mucro, the second equaling the spikelet, 5-nerved, the outer nerves submarginal and densely ciliate; sterile lemma similar but usually of a firmer texture than the second glume, the margins glabrous or

with a few weak hairs, enclosing a short cleft palea and sometimes a staminate flower; fertile lemma chartaceous-indurate, smooth, with an awn as much as 3 mm. long, the margins thin and delicately ciliolate, the palea of a similar texture. Perennials (ours) with densely tufted culms and few to several subdigitate racemes.

TYPE SPECIES: *Alloteropsis semialata* (R. Br.) Hitchc. (*Panicum semialatum* R. Br.).

1. **Alloteropsis semialata** (R. Br.) Hitchc., Contr. U. S. Nat. Herb. 12: 210. 1909; Brittonia 2: 124. 1936.

Panicum semialatum R. Br., Prodr. Fl. Nov. Holl. 1: 192. 1810; F. Muell., Pap. Pl. 2: 19. 1885; Maiden, Grass. N. S. Wales 33. *pl.* 1898. Type from Australia.

Urochloa semialata (R. Br.) Kunth, Rev. Gram. 1: 31. 1829.

Alloteropsis distachya Presl, Rel. Haenk. 1: 344. *pl. 47.* 1830; Scribn., Missouri Bot. Gard. Rep. 10: 37. *pl. 23.* 1899. Type probably from Luzon, Philippines, but the locality incorrectly cited by Presl as California.[11]

Coridochloa semialata (R. Br.) Nees, Jour. Bot. Kew Misc. 2: 97. 1850.

Axonopus semialatus (R. Br.) Hook. f., Fl. Brit. Ind. 7: 64. 1896.

Perennial; culms densely caespitose, slender, erect, 30–100 cm. tall, glabrous, or more or less pubescent below the inflorescence, the nodes somewhat bearded; basal sheaths velvety-villous, forming a compact tufted base to the culm, upper sheaths glabrous to more or less pilose; ligule membranous, erose, about 0.3 mm. long; blades linear, 10–30 cm. long, 3–7 mm. wide, flat, involute in drying, glabrous to papillose-pilose, especially below; racemes 2–4, 3–15 cm. long, subdigitate, the rachis slender, angled, villous; spikelets ovate-lanceolate, 5–6 mm. long; first glume about half as long as the spikelet, 3-nerved, mucronate or awn-tipped; second glume pointed or awn-tipped, densely ciliate, the hairs appressed at first, finally widely spreading; sterile lemma similar to the second glume but slightly more firm, awnless, often sparsely ciliolate on the margins, enclosing a short hyaline cleft palea and often a staminate flower; fertile lemma chartaceous-indurate, bearing an awn as much as 3 mm. long, the margins ciliolate.

BRITISH NEW GUINEA: Central Division: Kanosia, *Carr 11054, 11546* (NY) (on open savannah land); Port Moresby to Kalo, *MacGregor 37* (US); Northern Division: About 9 miles northwest of Oro Bay, *Reeder 802* (A, US) (in rich black soil of grassland); Western Division: Wuroi, Oriomo River, alt. 10–30 m., *Brass 5745* (US) (on savannah ridges); Daru Island, *Brass 6343* (A, US) (on hard-packed soil of roadways); Lake Daviumbu, Middle Fly River, *Brass 7924* (A, US) (occasional on savannah slopes); Tarara, Wassi Kussa River, *Brass 8409* (A, US) (common on ridges in savannah forests); Goodenough Island: Malauna Creek, *Burcham 131* (US) (occasional along creek bed and banks). NORTHEAST NEW GUINEA: Morobe District: Wau, *Clemens 10459bis* (US).

Tropical regions of the Eastern Hemisphere.

11. Hymenachne Beauv.

Hymenachne Beauv., Ess. Agrost. 48. *pl. 10, fig. 8.* 1812.

Spikelets acuminate, short-pediceled in dense spikelike or interrupted panicles; first glume acute to acuminate, 3–5-nerved, one-third to half as long as the spikelet, separated from the second glume by a distinct inter-

[11] See Hitchcock, Contr. U. S. Nat. Herb. 12: 210. 1909.

node; second glume and sterile lemma 5-nerved, acuminate, the lemma longer and often with an awn-like tip; fertile lemma pale, membranous, the margins not inrolled, the tip of the palea free. Coarse aquatic perennials with broad, firm, cordate-clasping blades and long contracted or spikelike panicles with densely flowered branches.

TYPE SPECIES: *Hymenachne amplexicaulis* (Rudge) Nees (*Panicum amplexicaule* Rudge).

1. **Hymenachne amplexicaulis** (Rudge) Nees, Agrost. Bras. 276. 1829; Pilger, Nat. Pflanzenfam. ed. 2. **14e:** 49. *fig. 26.* 1940; Chase, Jour. Arnold Arb. 20: 312. 1939.
   Panicum amplexicaule Rudge, Pl. Guiana 1: 21. *pl. 27.* 1805; Trin., Sp. Gram. Ic. 2: *pl. 205.* 1829. Type from British Guiana.

Coarse aquatic perennial; culms succulent, rather stout, usually 1–2 meters or more long, often decumbent below and rooting at the nodes; sheaths rather loose, often overlapping, glabrous or ciliate on the margins; ligule membranous, 1–2 mm. long; blades flat, rather firm, about 15–35 cm. long, 1.5–3 cm. wide, acuminate, gradually narrowed from the cordate-clasping base, the margins scabrous, more or less papillose-hispid-ciliate at the base; panicles 15–30 cm. long, spikelike, the lower branches often distant; spikelets 3.5–5 mm. long, acuminate, the second glume and sterile lemma scabrous on the nerves, the lemma often awn-pointed; fertile lemma thin-membranous, about 3 mm. long.

BRITISH NEW GUINEA: Western Division: Lake Daviumbu, Middle Fly River, *Brass 7613* (A, US) (sporadic in *Oryza* and *Leersia* stands of swamp margins). NETHERLANDS NEW GUINEA: Bruine River, alt. about 100 m., *Docters van Leeuwen 11149* (GH).

Tropical and subtropical regions of both hemispheres.

12. Digitaria Heist. ex Haller [12]

Digitaria Heist. ex Haller, Hist. Stirp. Helvet. 2: 244. 1768; Scop., Fl. Garn. ed. 2. 1: 52. 1772.
Syntherisma Walt., Fl. Carol. 76. 1788.

Spikelets lanceolate or elliptic, nearly plano-convex, in twos or threes, rarely solitary, subsessile or short-pediceled, alternate in two rows on one side of a 3-angled, winged or wingless rachis, the back of the fertile lemma turned toward it; glumes unequal, the first minute or wanting, the second as long as the spikelet or shorter; sterile lemma as long as the spikelet; fertile lemma cartilaginous, the margins hyaline, not inrolled. Annual or perennial, often weedy grasses with membranous or hyaline ligules and slender racemes digitate or approximate on a short axis.

TYPE SPECIES: *Digitaria sanguinalis* (L.) Scop. (*Panicum sanguinale* L.).

KEY TO THE SPECIES

1. Spikelets 5–6 mm. long; sterile lemma 11–13-nerved.....1. *D. longissima.*
1. Spikelets not more than 3.5 mm. long; sterile lemma 5–7-nerved.
   2. Spikelets 1.5 mm. long.
      3. Spikelets glabrous; plants tufted, less than 10 cm. tall.....9. *D. perpusilla.*

[12] For a discussion of the date and place of valid publication of this generic name see Hitchcock (Rhodora 29: 114–116. 1927). According to the International Rules (Art. 42) the correct citation is "Digitaria Heist. ex Haller," and not "Heist. ex Scop." as Hitchcock indicates.

3. Spikelets more or less pubescent; plants larger.
   4. Fertile lemma pale; plants creeping.....7. *D. longiflora.*
   4. Fertile lemma dark brown; plants erect, 40–60 cm. tall....8. *D. violascens.*
2. Spikelets 2.5 mm. or more long (only about 2 mm. in *D. Baileyi*).
   5. First glume wanting or minute; second glume about one-third as long as the spikelet or shorter.
      6. Racemes mostly 8–10, approximate, not digitate; first glume often wanting.. .....4. *D. pruriens.*
      6. Racemes 3–5, digitate or rarely 1 or 2 below; first glume a small deltoid scale .....5. *D. radicosa.*
   5. First glume small but distinct; second glume half as long as the spikelet or longer.
      7. One spikelet of the pair usually undeveloped; blades strict..3. *D. abortiva.*
      7. Both spikelets of the pair well developed; blades lax and spreading.
         8. Sheaths papillose-pilose; spikelets about 3 mm. long....2. *D. sanguinalis.*
         8. Sheaths glabrous; spikelets 2.5 mm. long or shorter.....6. *D. Baileyi.*

1. **Digitaria longissima** Mez, Repert. Sp. Nov. 18: 26. 1922. Type from New Ireland.

   Panicum heteranthum Nees & Mey. var. *pachyrachis* Hack., Philip. Jour. Sci. Bot. 3: 167. 1908. Type from the Philippines.

   Digitaria heterantha (Nees & Mey.) Merr. var. *pachyrachis* (Hack.) Merr., Enum. Philip. Fl. Pl. 54. 1925.

Perennial; culms glabrous, ascending and creeping, as much as 1 meter long; sheaths glabrous, somewhat keeled; ligule 2–3 mm. long, subtruncate, denticulate; blades flat, rather firm, 5–7 mm. wide, as much as 15 cm. long, both surfaces glabrous, scabrous on the margins; racemes 2–4, digitate, erect or somewhat spreading, 12–18 cm. long, the rachis glabrous, rather broad and thick; spikelets paired, 5–6 mm. long, one nearly sessile, the other on a pedicel about two-thirds the length of the spikelet or longer, the pedicel rather stout and somewhat hollowed out on the side next to the lower spikelet; first glume obsolete, obtuse to bifid; second glume half to two-thirds as long as the spikelet, 3-nerved, silky-pubescent between the nerves; sterile lemma 11–13-nerved, glabrous except for the silky-pubescent margins; fertile lemma pale.

NEW IRELAND: *Peekel 301* (US, TYPE fragment).

New Ireland; Peleliu to the Philippines.

Closely related to *Digitaria barbata* Willd., to which specimens have been referred, but differing in having somewhat larger nearly glabrous spikelets, in which the sterile lemma is 11–13-nerved rather than 7–9-nerved, usually a broader and thicker rachis, and leaves of a somewhat firmer texture. The two also differ in habit, *D. barbata* being very stoloniferous while *D. longissima* has decumbent and creeping culms but no true stolons.

Judging from the original description, *Digitaria Kanehirae* Ohwi (56, p. 543), described from Peleliu, seems referable to *D. longissima*. This latter species is known to occur in Peleliu, since a specimen in the U. S. National Herbarium (*Burcham 150*) was collected there in 1944.

2. **Digitaria sanguinalis** (L.) Scop., Fl. Carn. ed. 2. 1: 52. 1772.

   Panicum sanguinale L., Sp. Pl. 57. 1753; Trin., Sp. Gram. Ic. 1: *pl. 93, 94.* 1828. Habitat in America and Europe.

   Panicum adscendens H.B.K., Nov. Gen. et Sp. 1: 97. 1815. Habitat in tropical America.

Digitaria marginata Link, Enum. Pl. 1: 102. 1821. Type from Brazil.
Digitaria fimbriata Link, Hort. Berol. 1: 226. 1827. Type from Brazil.
Syntherisma sanguinalis (L.) Dulac., Fl. Haut. Pyr. 77. 1867.
Syntherisma fimbriata (Link) Nash, Bull. Torr. Bot. Club 25: 302. 1898.
Syntherisma marginata (Link) Nash, N. Amer. Fl. 17: 154. 1912.
Digitaria adscendens (H.B.K.) Henr., Blumea 1: 92. 1934.

Annual; culms weak and spreading, as much as 1 meter long, profusely branching below, glabrous; sheaths, at least the lower, papillose-pilose; ligule about 2 mm. long, erose; blades 3–8 mm. wide, 4–10 cm. long, glabrous or somewhat pubescent; racemes about 3–10, sometimes only 2, unequal in length, digitate or in two whorls; rachis winged, the wings slightly broader than the central rib, glabrous except for the scabrous margins; spikelets lanceolate-elliptic, about 3 mm. long; first glume small but distinct; second glume half as long as the spikelet or longer, narrow, 3-nerved, ciliate; sterile lemma strongly nerved, the lateral internerves appressed-pubescent, the hairs sometimes spreading at maturity; fertile lemma pale to tawny.

BRITISH NEW GUINEA: Central Division: Hisiu, *Carr 11439* (US, NY). NORTHEAST NEW GUINEA: Morobe District: Finschhafen, *Sawyer 83, 92* (A).

Common weed in cultivated and waste ground in tropical and temperate regions of both hemispheres.

Extremely variable in the amount of indument on the sterile lemma, some specimens appearing almost glabrous, while others have spikelets which are strongly fimbriate. Plants with this latter condition have been segregated and given varietal or even specific rank (*Digitaria fimbriata* Link). These segregates seem untenable, however, when it is seen that spikelets varying from essentially glabrous to strongly fimbriate may be found in the same inflorescence. *Carr 11439* is exceptional in having a pilose rachis.

Many of the early reports of this species from New Guinea may have been misidentifications for the closely related *Digitaria pruriens*.

3. **Digitaria abortiva** sp. nov. PLATE II.

Annua 25–50 cm. alta; culmis glabris, gracilibus, erectis vel adscendentibus; vaginis carinatis, papilloso-pilosis, quam internodiis longioribus; ligula membranacea, erosa, circiter 2 mm. longa; laminis strictis, lanceolato-linearibus, 2–8 cm. longis, 2–5 mm. latis, utrinque scabris et supra plus minusve papilloso-pilosis; pedunculo longe exserto; racemis 3–4 (rarius 7), digitatis vel approximatis, 4–7 cm. longis, floribus confertis, rhachi anguste alata, ad imam basin minute pubescente, marginibus scabris; spiculis circiter 2.5 mm. longis, plerumque solitariis, ad basin pedicelli abortivum ut videtur spiculum ferentibus; gluma prima scariosa, circiter 0.2 mm. longa, acuta; gluma secunda angusta, 3-nervia, quam spicula circiter tertia parte breviore, marginibus et inter nervos adpresse sericeo-pubescentibus, denique pilis plus minusve patentibus; lemmate sterili 5-nervia, nervis tribus prominentibus, ceteris obscuris, marginibus scariosis, plus minusve sericeo-pubescentibus, inter nervos sparsim pubescente; lemmate fertili straminea vel subfusca.

BRITISH NEW GUINEA: Central Division: Kanosia, *Carr 11108* (US, NY, TYPE), Feb. 5, 1935 (in open savannah land).

Related to *Digitaria sanguinalis*, but differing in the more erect habit, smaller strict leaves, long exserted inflorescence, and smaller spikelets which are usually borne singly rather than in pairs. Comparison may also be made with *D. Henryi* Rendle, but that species has a spreading habit, paired spikelets, glabrous sheaths, and a sterile lemma strongly 5–7-nerved. *Digitaria abortiva* has three strong nerves and usually two additional weak nerves, one on each side of the midnerve. *Digitaria Henryi* is not known from New Guinea. The specific epithet refers to the fact one spikelet of the pair usually fails to develop, being represented merely by a small vestige at the base of the pedicel of the solitary spikelet.

4. **Digitaria pruriens** (Fisch. ex Trin.) Buse in Miquel, Pl. Jungh. 379. 1854; Hitchc., Brittonia 2: 120. 1936.

Panicum pruriens Fisch. ex Trin., Gram. Pan. 77. 1826, Sp. Gram. Ic. 1: *pl. 92.* 1828; Hack., Bot. Jahrb. 6: 234. 1885. "Ex Inss. Sandw. et Marchion."

Panicum microbachne Presl, Rel. Haenk. 1: 298. 1830.[13]

Digitaria consanguinea Gaud. in Freyc., Voy. Uran. 410. 1830. Type from Hawaiian Islands.

Panicum sanguinale L. var. *microbachne* (Presl) Hack., Bot. Jahrb. 13: 259. 1890; K. Schum., Notizbl. Bot. Gart. Berlin 2: 92. 1898.

Syntherisma pruriens (Fisch. ex Trin.) J. C. Arthur, Torreya 19: 83. 1919.

Syntherisma microbachne (Presl) Hitchc., Mem. Bishop Mus. 8: 177. 1922.

Digitaria microbachne (Presl) Henr., Med. Rijks Herb. Leiden 61: 13. 1930.

Annual; culms ascending or decumbent, as much as 1 meter or more long, glabrous, branching and rooting from the lower nodes; sheaths mostly shorter than the internodes, glabrous to more or less densely papillose-pilose; ligule 2–4 mm. long; blades 5–15 (rarely 20) cm. long, 5–10 mm. wide, lax, glabrous or slightly pubescent below, scabrous and often undulate on the margins; racemes 8–10, aggregated, 8–14 cm. long, erect or somewhat spreading, the rachis angled and with scabrous margins; pedicels angled or narrowly winged, the longer 1.5–2 mm. long; spikelets more or less pubescent, lanceolate-elliptic, 2.5–3 mm. long; first glume wanting or very small, second glume about one-third as long as the spikelet or reduced to a minute nerveless scale; sterile lemma equaling or slightly exceeding the fertile one, 5–7-nerved; fertile lemma pale.

BRITISH NEW GUINEA: Northern Division: About 1 mile north of East Embi Lake, *Reeder 829* (A, US) (in abandoned native garden); Central Division: Mafulu, *Brass 5522* (A, US) (old garden and deforested land); Kanosia, *Carr 11031* (NY) (light shade); Hisiu, *Carr 11440* (NY) (open places); Western Division: Daru Island, *Brass 6305* (A, US) (common weed in gardens); Goodenough Island: Haiwali, *Burcham 120* (US) (grassy clearing in rainforest). NORTHEAST NEW GUINEA: *Weinland 75* (US); Morobe District: Near Kajabit Mission, alt. about 300 m., *Clemens 10630* (US). NEW BRITAIN: *Parkinson 66* (US).

China to the Philippines, Malaysia, New Guinea, and many Pacific Islands.

[13] In the original description no habitat is given, but a Haenke sheet in the herbarium of the National Museum, Prague (photograph and fragment at US) shows three specimens. Of these, the center one (a smaller specimen) is labelled "Mexico"; the one on the right bears the label "*Panicum microbachne*," while the one on the left has a label "Sorsogon." The two larger specimens seem to be the same and are taken as the type. The photograph and spikelets agree well with Presl's description. This would make the type locality Sorsogon, Luzon, Philippines.

Closely related to *Digitaria sanguinalis,* but differing in having an obsolete first glume and the second glume obsolete to one-third the length of the spikelet.

5. **Digitaria radicosa** (Presl) Miq., Fl. Ind. Bat. 3: 437. 1855.
Panicum radicosum Presl, Rel. Haenk. 1: 297. 1830. Type from the Philippines.

Annual; culms ascending, 40–80 cm. long, branching and rooting from the lower nodes; sheaths mostly shorter than the internodes, the lower often somewhat pubescent, the upper glabrous; ligule 1–2 mm. long, truncate, erose; blades 4–12 cm. long, 4–7 mm. wide, scaberulous on both surfaces, sometimes with a few hairs on the upper surface near the ligule, margins scabrous and often undulate, midnerve prominent, whitish; racemes usually about 3 (sometimes only 2 or as many as 5), digitate, mostly 7–15 cm. long, suberect to somewhat spreading, the rachis narrowly winged; spikelets paired, lanceolate, about 3 mm. long; first glume minute but evident; second glume about one-third the length of the spikelet, narrow, pubescent along the margins; sterile lemma about equaling the fertile one, appressed-pubescent along the margins, the soft white hairs often somewhat spreading; fertile lemma pale.

BRITISH NEW GUINEA: Northern Division: About 9 miles northwest of Oro Bay, *Reeder 817* (A, US) (in jungle clearing, forming mats); Western Division: Gaima, Lower Fly River, *Brass 8324* (A, US) (abundant as a weed in native gardens). NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11813* (A, US) (abundant as a weed in old gardens); Nassau Region, Explorat Biv., *Docters van Leeuwen 10498* (NY).

China to the Philippines and New Guinea.

Closely related to *Digitaria pruriens,* but a more delicate species with thinner, narrower blades, more slender culms, essentially glabrous foliage, and fewer, more lax racemes.

6. **Digitaria Baileyi** (Benth.) Hughes, Kew Bull. 1923: 308. 1923.
Panicum Baileyi Benth., Fl. Austral. 7: 471. 1878; F. M. Bailey, Compr. Cat. Queensl. Pl. *fig. 586.* 1909–13. Type from Australia.

Culms ascending or suberect, 50–100 cm. tall, slender, glabrous, but the lower internodes under a lens very minutely papillose-roughened, the nodes glabrous; sheaths scaberulous, shorter than the internodes, slightly keeled toward the summit, the hyaline margins extending into slight auricles 2–3 mm. long connected by the slightly shorter brownish ligule; blades flat, 7–14 cm. long, 3–5 mm. wide, scabrous on both surfaces, the pale midnerve rather prominent below; inflorescence long-exserted, of 6–9 slender ascending to spreading racemes on a slender angled axis about 8 cm. long, the lower two often rather distant; racemes 6–15 cm. long, the slender angled rachis puberulent in the axil, scabrous on the angles, interrupted below, the lowermost with appressed branchlets of 2–4 spikelets at the base; pedicels angled, scabrous, the longer about 2 mm. long; spikelets in pairs or often in threes, 2–2.5 mm. long; first glume hyaline, minute to nearly 0.5 mm. long; second glume about half to three-fourths as long as the spikelet, 3–5-nerved, fringed with silky hairs about 0.5 mm. long; sterile lemma 7-nerved, the outer internerves on each side bearing silky hairs similar to those of the second glume, these appressed to somewhat spreading; fertile lemma pale.

BRITISH NEW GUINEA: Central Division: Astrolabe Range, *Arnot 38* (US); Western Division: Tarara, Wassi Kussa River, *Brass 8695* (A, US) (common weed in deserted gardens).

Australia and New Guinea.

Brass 8695 was cited by Chase (17, p. 307) as *Digitaria quinhoensis* A. Camus (type fragment at US), an Indo-Chinese species of similar size and habit but bearing larger spikelets (3 mm. long), which are much less pubescent and have the first pair of lateral nerves on the sterile lemma close to the midrib, the second glume only about one-third as long as the spikelet, and a fertile lemma which is brown at maturity.

7. **Digitaria longiflora** (Retz.) Pers., Syn. Pl. 1: 85. 1805; Hitchc., U. S. Dept. Agric. Misc. Publ. 243: 171. *fig. 110*. 1936.

Paspalum longiflorum Retz., Obs. Bot. 4: 15. 1786. Type from India.

Panicum longiflorum (Retz.) Gmel., Syst. Nat. 2: 158. 1791.

Syntherisma longiflora (Retz.) Skeels, U. S. Dept. Agric. Bur. Pl. Indust. Bull. 261: 30. 1912.

Perennial; culms glabrous, creeping and producing stolons, forming dense mats, the upright flowering portion about 15 cm. or more tall; sheaths glabrous, shorter than the internodes; ligule membranous, more or less truncate, erose, about 1 mm. long; blades ovate-lanceolate, about 1.5–2 cm. long, 3 mm. wide, glabrous on both surfaces, the margins slightly coriaceous-thickened and scaberulous; racemes mostly in pairs, densely flowered, 3–4 cm. long, the slender rachis winged, glabrous, the wings broader than the midnerve; pedicels terete, glabrous, the longer not more than 1 mm.; spikelets minutely pubescent, about 1.5 mm. long and 0.6 mm. broad; first glume a delicate hyaline scale; second glume equaling the spikelet, 5-nerved; sterile lemma 7-nerved; fertile lemma pale.

BRITISH NEW GUINEA: Northern Division: About 9 miles northwest of Oro Bay, *Reeder 811* (A, US) (forming dense mats at the edge of a water hole).

Japan to India, Malaysia, and New Guinea. Introduced in tropical America.

8. **Digitaria violascens** Link, Hort. Berol. 1: 229. 1827; Hitchc., U. S. Dept. Agric. Misc. Publ. 243: 170. *fig. 109*. 1936; Chase, Jour. Arnold Arb. 24: 86. 1943. Type from Brazil.

Panicum violascens (Link) Kunth, Rev. Gram. 1: 33. 1829; Hack., Bot. Jahrb. 13: 259. 1890.

Paspalum chinensis Nees in Hook. & Arn., Bot. Beechey Voy. 231. 1836. Type from China.

Paspalum minutiflorum Steud., Syn. Pl. Glum. 1: 17. 1854 (non Desv. 1831); F. Muell., Vict. Nat. 1: 168. 1884. Type from China.

Digitaria chinensis (Nees) A. Camus, Not. Syst. Lecomte 4: 48. 1923 (non Hornem. 1819).

Syntherisma chinensis (Nees) Hitchc., Contr. U. S. Nat. Herb. 22: 468. 1922.

Annual; culms erect, tufted, slender, 50–70 cm. tall, glabrous; sheaths glabrous, mostly shorter than the internodes; ligule more or less truncate, slightly erose; blades glabrous, linear, 6–15 cm. long, 3–6 mm. wide; racemes 3–7, 6–12 cm. long, densely flowered, digitate or approximate on a short axis, the glabrous rachis about 0.5 mm. wide, broadly winged and scaberulous along the margins; pedicels terete to slightly flattened, minutely scabrous, as much as 2 mm. long; spikelets elliptic, about 1.5 mm. long and 0.7 mm. wide; first glume wanting; second glume slightly shorter than the spikelet, 3-nerved, pubescent between the nerves and along the

margin; sterile lemma about equaling the fertile one with 3 distinct nerves and one or two obscure pairs, and with indument like that of the second glume; fertile lemma dark brown at maturity.

BRITISH NEW GUINEA: Northern Division: About 9 miles northwest of Oro Bay, *Reeder 833* (A, US) (in old abandoned jeep trail). NORTHEAST NEW GUINEA: Morobe District: Above Molambing River, alt. about 2000 m., *Clemens 10359* (US). NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11822* (A, US) (sandy soil on deforested slopes).

Tropics of both hemispheres.

Readily distinguished from *D. longiflora* by its erect habit, longer leaves and racemes, and the dark brown fertile lemma.

9. **Digitaria perpusilla** Pilger, Bot. Jahrb. 69: 253. 1938.

Annual; culms slender, tufted, 4–7 cm. tall, glabrous; sheaths longer than the internodes, pilose, the hairs spreading, white, about 0.5 mm. long; ligule about 0.5 mm. long, more or less truncate, slightly erose; blades lanceolate, 6–8 mm. long, about 1 mm. wide, somewhat pilose with hairs similar to those of the sheath, the margins coriaceous-thickened and scaberulous; racemes in pairs, up to 20 mm. long, the slender rachis somewhat winged, scaberulous on the margins, glabrous, rather densely flowered, the pedicels up to 1.3 mm. long, mostly shorter; spikelets glabrous, elliptic, about 1.2 mm. long and 0.6 mm. wide; first glume wanting; second glume about two-thirds the length of the spikelet, 3-nerved, the margins hyaline; sterile lemma as long as the spikelet, 7-nerved, the three central nerves close together; fertile lemma dark brown at maturity, somewhat indurated except for the hyaline margins; palea similar to the lemma in texture; caryopsis oblong-ellipsoidal, white, the embryo small (about one-third the length of the caryopsis), brown.

NORTHEAST NEW GUINEA: Morobe District: Sarawaket, alt. about 3000 m., *Clemens 6120* (A, TYPE COLL., US).

Endemic. Known only from the type collection.

13. Eriochloa H. B. K.

Eriochloa H.B.K., Nov. Gen. et Sp. 1: 94. 1815.

Spikelets dorsally compressed, more or less pubescent, solitary or in pairs, short-pediceled or subsessile, in two rows on one side of a narrow, usually hairy rachis, the back of the fertile lemma turned away from it; rachilla below the second glume thickened into a ring- or bead-like callus; first glume wanting or reduced to a minute sheath surrounding the callus and adnate to it; second glume and sterile lemma subequal, membranous, acute or acuminate; fertile lemma indurate, minutely papillose-rugose, the margins slightly inrolled, the apex mucronate or short-awned. Annuals or perennials with terminal panicles consisting of few to many racemes racemose along the main axis.

TYPE SPECIES: *Eriochloa distachya* H.B.K.

1. **Eriochloa procera** (Retz.) C. E. Hubb., Kew Bull. 1930: 256. 1930.
Agrostis procera Retz., Obs. Bot. 4: 19. 1786. Type from India.
Milium ramosum Retz., Obs. Bot. 6: 22. 1791. Type from India.
Eriochloa ramosa (Retz.) Kuntze, Rev. Gen. 2: 775. 1891.

Annual or perennial; culms tufted or solitary, erect or ascending, 30–

100 cm. tall, glabrous or minutely puberulent, the indument more noticeable below the inflorescence; nodes glabrous to rather densely velvety-puberulent; sheaths glabrous or the lower slightly puberulent, keeled above; ligule a ring of whitish hairs 0.6–0.8 mm. long; blades glabrous, 4–20 cm. long, 2–8 mm. wide, flat or involute when dry; racemes few to many, simple or the lower ones branching, rather distant on a flattened puberulent axis about 0.5 mm. wide, scabrous on the angles; pedicels solitary or paired, the longer 1.5–2 mm. long, scabrous-hispidulous, the apex bearing long stiff hairs from one-fourth to as long as the spikelet; spikelets about 3 mm. long, sparsely appressed-pilose; first glume reduced to a minute sheath around the callus; second glume and sterile lemma subequal, 5-nerved, acuminate, the lemma usually slightly shorter, epaleate; fertile lemma pale, minutely rugose, about 2 mm. long, with an hispidulous mucro about 0.5 mm. long or less.

BRITISH NEW GUINEA: Central Division: Aroa River, *Carr 11435* (US, NY) (open sandy places).

Warmer regions of the Old World; introduced into tropical America.

A variable and wide ranging species. The cited specimens are somewhat unusual in being erect, densely tufted, and apparently perennial. The leaves are rather narrower than usual and are closely involute. In the character of the spikelets, however, I can find no significant differences.

14. Paspalum L.

Paspalum L., Syst. Nat. ed. 10. 2: 855. 1759.

Spikelets plano-convex, or sometimes unequally bi-convex or even concavo-convex, subsessile or short-pediceled, solitary or in pairs, in 2–4 rows on one side of a narrow or winged rachis, the back of the fertile lemma turned toward it; first glume typically wanting (sometimes slightly developed in *P. vaginatum*); second glume and sterile lemma usually similar, membranous (sterile lemma indurate in some specimens of *P. scrobiculatum*); fertile lemma and palea chartaceous-indurate, the margins of the lemma inrolled at maturity. Annual or perennial grasses of various habitat, widely distributed in the warmer regions of both hemispheres.

TYPE SPECIES: *Paspalum virgatum* L. [fide Pilger, Nat. Pflanzenfam. ed. 2. 14e: 59. 1940].

KEY TO THE SPECIES

1. Plants extensively creeping; long stolons or rhizomes present.
   2. Spikelets glabrous, 3.5–4 mm. long; blades involute.....1. *P. vaginatum.*
   2. Spikelets silky-ciliate on the margin, less than 2 mm. long; blades flat.....2. *P. conjugatum.*
1. Plants not creeping; culms sometimes more or less decumbent and rooting at base.
   3. Spikelets 1.5 mm. long or less; racemes lax, the rachis about 0.3 mm. wide; fertile lemma pale.....3. *P. paniculatum.*
   3. Spikelets 1.8 mm. or more long; racemes not lax, the rachis at least 1 mm. wide; fertile lemma brown at maturity.
      4. Glume and sterile lemma 3-nerved.
         5. Spikelets apiculate, in 4 rows (at least in the central part of the raceme).....6. *P. longifolium.*
         5. Spikelets obtuse, in two rows.....5. *P. orbiculare.*
      4. Glume and sterile lemma 5–7-nerved.....4. *P. scrobiculatum.*

1. **Paspalum vaginatum** Swartz, Prodr. Veg. Ind. Occ. 21. 1788; Trin., Sp. Gram. Ic. 1: *pl. 120.* 1828; Chase, Contr. U. S. Nat. Herb. 28: 41–45. *fig. 19.* 1929; Hitchc., Proc. Linn. Soc. N. S. Wales 54: 145. 1929. Type from Jamaica.
Paspalum littorale R. Br., Prodr. Fl. Nov. Holl. 1: 188. 1810. Type from Australia.
Paspalum distichum L. var. *littorale* (R. Br.) F. M. Bailey, Queensland Grasses 23. 1888; White, Proc. Roy. Soc. Queensl. 34: 15. 1923.

Perennials with long creeping rhizomes and also stoloniferous; flowering culms 8–60 cm. tall, glabrous; sheaths longer than the internodes, overlapping, often keeled, the margins hyaline, glabrous except for a few weak hairs near the ligule; ligule membranous, about 0.5 mm. long; blades 2.5–15 cm. long, 3–8 mm. wide at base, narrower than the summit of the sheath, more or less involute; racemes usually 2 (rarely 3–5), conjugate or closely approximate at first, often spreading or reflexed at maturity; rachis 1–2 mm. wide, 3-angled, often distinctly zig-zag, especially toward the end; spikelets solitary, imbricate, elliptic, glabrous, 3.5–4 mm. long; first glume wanting or rarely slightly developed; second glume and sterile lemma equal, thin, weakly 5-nerved, but the midnerve of the second glume often suppressed, the sterile lemma often transversely undulate; fertile lemma 2.5–3 mm. long, slightly concave-convex, and with a tuft of short stiff hairs at the apex, clasping the palea for only about two-thirds of its length.

British New Guinea: Gulf Division: Krema, *Brass 1229* (GH, US); Western Division: Daru Island, *Brass 6285* (A, US); coast between Oriomo and Fly Rivers, *Brass 6408* (A, US) (open beach).

Tropical and subtropical coasts of both hemispheres.

Often confused with *P. distichum* L., a closely related species which differs in having more turgid spikelets, an appressed-pubescent rather than glabrous second glume, and the fertile lemma clasping the palea for its entire length.

2. **Paspalum conjugatum** Bergius, Act. Helv. Phys. Math. 7: 129. *pl. 8.* 1762; Trin., Sp. Gram. Ic. 1: *pl. 102.* 1828; K. Schum. and Lauterb., Fl. Deutsch. Schutzgeb. Südsee 176. 1901; Chase, Contr. U. S. Nat. Herb. 28: 162–168. *fig. 105.* 1929; Hitchc., U. S. Dept. Agric. Misc. Publ. 243: 226. *fig. 177.* 1936; Pilger, Nat. Pflanzenfam. ed. 2. 14e: 61. *fig. 33.* 1940. Type from Surinam.

Perennial; extensively creeping with leafy, compressed, wiry stolons, as much as 2 meters long, the upright flowering branches 20–60 cm. tall, simple or sparingly branching, glabrous or the nodes often pubescent, those of the stolons usually conspicuously pilose; sheaths loose, compressed, the margins ciliate, at least on the upper half, often pubescent on the collar, otherwise glabrous; ligule membranous, about 0.5 mm. long and with a ring of white hairs back of it, these as much as 2 mm. long; blades flat, thin, 8–12 cm. long, 5–15 mm. wide, the margins scabrous or ciliate-hispid, usually glabrous below and sparsely pubescent to glabrous above; racemes in pairs, rarely a third below, widely divergent, 8–12 cm. long, the rachis flattened; spikelets solitary, 1.5–1.7 mm. long, ovate, light yellow, conspicuously silky-ciliate on the margins, otherwise glabrous; second glume and sterile lemma equal; fertile lemma pale, not strongly indurate.

British New Guinea: Central Division: Dieni, Ononge Road, alt. 500 m., *Brass 3935* (A, US) (common along roadside and covering rest-house clearing); Kanosia, *Carr 11025* (US); Northern Division: About 7 miles northwest of Oro Bay, *Reeder 799* (A, US) (in sandy soil of borrow pit, forming mats); West-

ern Division: Gaima, Lower Fly River, *Brass 8325* (A, US) (massed as a weed in native gardens). NORTHEAST NEW GUINEA: Morobe District: Finschhafen area, four miles south of Langemak Bay, *Sawyer 34, 108* (A). NETHERLANDS NEW GUINEA: Reese Region, Gelder River, alt. about 100 m., *Docters van Leeuwen 9252* (GH). SOLOMON ISLANDS: San Cristoval: *Brass 2817* (GH).

Widely distributed in the tropics and subtropics of both hemispheres.

3. **Paspalum paniculatum** L., Syst. Nat. ed. 10. 2: 855. 1759;[14] Trin., Sp. Gram. Ic. 2: *pl. 127*. 1829.

Perennial; culms caespitose, suberect or ascending, 50–100 cm. tall, glabrous or the nodes often more or less pubescent with stiff ascending hairs; sheaths usually longer than the internodes, keeled, papillose-hispid to papillose-pilose, the hairs as much as 5 mm. long; ligule about 0.5 mm. long, membranous, and bearing behind it a dense row of white hairs as much as 12 mm. long; blades flat, spreading, 10–40 cm. long, 10–25 mm. wide, from coarsely hispid on both surfaces and with a long tuft of white hairs at the base to scabrous or sometimes glabrous except at base and along the margin, the midnerve prominent beneath; panicle 10–20 cm. long, of numerous spreading to somewhat drooping racemes, the lowermost as much as 10 cm. long; spikelets in pairs, subhemispheric, 1.3–1.5 mm. long, on slender pedicels, crowded along the slender angled rachis; glume and sterile lemma equal, 5-nerved, the lateral pair contiguous, glume loosely pubescent with delicate hairs, the sterile lemma with similar hairs along the margin, sometimes throughout; fertile lemma pale.

BRITISH NEW GUINEA: Northern Division: About 8 miles northwest of Oro Bay, *Reeder 805* (A, US) (growing in sand at edge of coconut grove); Goodenough Island: Two miles west of Haiwali, *Burcham 134* (US) (scanty soil among boulders in dense secondary growth near native village).

Mexico and the West Indies to Argentina, West Africa, Society Islands, Australia, and New Guinea.

4. **Paspalum scrobiculatum** L., Mant. 1: 29. 1767; F. Muell., Pap. Pl. 2: 35. 1886. Type from India.

Paspalum cartilagineum Presl, Rel. Haenk. 1: 216. 1830; K. Schum. and Lauterb., Fl. Deutsch. Schutzgeb. Südsee 175. 1901. Type from the Philippines.

Paspalum Zollingeri Steud., Syn. Pl. Glum. 1: 28. 1854; K. Schum., Bot. Jahrb. 9: 195. 1887. Type from Java.

Culms solitary or tufted, 50–100 cm. tall, erect or ascending, sometimes somewhat decumbent and rooting from the lower nodes, often rather stout; sheaths glabrous, longer than the internodes, compressed-keeled, especially toward the summit; ligule membranous, 0.5–1 mm. long, with a row of tawny hairs back of it, or these sometimes wanting or obscure; blades glabrous, firm, flat or folded, 15–50 cm. long, 7–12 mm. wide, the margins scabrous, the upper surface more or less glaucous; racemes 2–5 (rarely up to 8), alternate on a slender, glabrous, angled axis; rachis 1.5–3 mm. wide, the margins minutely scabrous; spikelets solitary, imbricate, glabrous, orbicular to ovate, 2–3 mm. long; second glume membranous, 5-nerved; sterile lemma 5–7-nerved, membranous or sometimes indurate (*P. cartilagineum* Presl); fertile lemma dark brown at maturity.

BRITISH NEW GUINEA: Northern Division: About 9 miles northwest of Oro Bay, *Reeder 818* (US) (open, low swampy ground); about 3 miles south of

[14] No locality is cited, but in Sp. Pl. ed. 2. 81. 1762, Linnaeus gives the habitat as Jamaica. See Chase, Contr. U. S. Nat. Herb. 28: 122. 1929.

Dobodura, near Sambogo River, *Reeder 826* (US); Gulf Division: Maclatchi Point, *Brass 1183* (GH, US) (in clumps on the beach); Western Division: Daru Island, *Brass 6297* (A, US) (common on wet pathways and in garden clearings); Palmer River, 1 mile above junction with Black River, *Brass 6948* (A, US) (sand binder on gravel banks); Lake Daviumbu, Middle Fly River, *Brass 7529* (A, US) (restricted to swamp margins); Gaima, Lower Fly River, *Brass 8302* (A, US) (associated with sedges on open sandy foreshores); Goodenough Island: Malauna Creek, *Burcham 129* (US) (scanty moist soil along creek bed and banks). NORTHEAST NEW GUINEA: Morobe District: 4 miles south of Langemak Bay, near Finschhafen, *Sawyer 94* (A). NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11817* (A, US) (rare on deforested slopes); Bernhard Camp, Idenburg River, alt. 50 m., *Brass 13784* (A, US) (on logs floating in lagoons and quiet backwater).

Tropics and subtropics of the Old World.

A variable species, but readily distinguished by its robust habit and 7-nerved sterile lemma. *Paspalum cartilagineum* is here considered as a synonym, since there is no reliable character by which it may be separated. The indurate sterile lemma might seem to be specific, but this breaks down when it is found that on the same plant both indurate and membranous sterile lemmas may be present. Some spikelets show half the sterile lemma indurate and the other half membranous.

4a. **Paspalum scrobiculatum** L. var. **bispicatum** Hack. ex. Merr., Fl. Manila 86. 1912; Kneuck., Allg. Bot. Zeitschr. 20: 146. 1914. Type from the Philippines.

Distinguished from the species by its slender culms 30–50 cm. tall and its 2 (rarely 3) racemes 3–5 cm. long, usually not more than 1 cm. distant. The inflorescence is typically long exserted on a slender peduncle and the spikelets are orbicular to elliptic, about 2 mm. long.

BRITISH NEW GUINEA: Northern Division: About 9 miles northwest of Oro Bay, *Reeder 815* (A, US) (rather common in wet areas, forming rosette-like clumps); Goodenough Island: Haiwali, *Burcham 122* (US) (grassy clearing in rain-forest; well drained sandy loam).

India to China, the Philippines, and New Guinea.

5. **Paspalum orbiculare** G. Forster, Fl. Ins. Austr. Prodr. 7. 1786; Hack., Bot. Jahrb. 13: 258. 1890; Hitchc., Mem. Bishop Mus. 8(3): 178. *fig. 68*. 1922. Type from the Society Islands.

Paspalum scrobiculatum L. *β orbiculare* (G. Forster) Hack., Bot. Jahrb. 6: 233. 1885.

Culms tufted, erect, glabrous, 40–80 cm. tall; sheaths glabrous, longer than the internodes, compressed-keeled especially toward the summit; ligule membranous, about 0.75 mm. long; blades elongate, flat or sometimes folded, 5–10 mm. wide, the upper surface somewhat glaucous and sometimes with a few long hairs near the ligule, the margins minutely scabrous; inflorescence long-exserted, consisting of 3–5 (rarely to 7) racemes, 3–6 cm. long, alternate and 1–2 cm. distant on a slender axis; rachis 1.5–3 mm. wide, scabrous on the margins; spikelets glabrous, oval to nearly circular with obtuse apex, about 2 mm. long, usually solitary (occasionally paired), imbricate, in 2 rows (rarely 3 or 4 rows) on the rachis; glume and sterile lemma equal, thin, 3-nerved; fertile lemma brown at maturity.

BRITISH NEW GUINEA: Goodenough Island: Malauna Creek, *Burcham 130* (US) (occasional in moist spots along creek bed and banks). NORTHEAST NEW GUINEA: Morobe District: Four miles south of Langemak Bay (near

Finschhafen), *Sawyer 93* (A); Wantoat, alt. about 1000 m., *Clemens 11047* (US). SOLOMON ISLANDS: San Cristoval: Waimaura, *Brass 2841* (GH).

Tropics and subtropics of the Old World.

Readily distinguished from *Paspalum scrobiculatum* by its 3-nerved glume and sterile lemma and its usually more numerous racemes, which are distant on the axis. The species may also be compared with *P. longifolium,* but that species has apiculate spikelets which are borne in pairs and are in four rows, at least in the central part of the raceme. The racemes are usually much more numerous and the rachis is broader.

6. **Paspalum longifolium** Roxb., Hort. Beng. 7. 1814, nomen, Fl. Ind. 1: 283. 1820, descr.; Trin., Sp. Gram. Ic. 2: *pl. 138.* 1829; F. Muell., Pap. Pl. 1: 74. 1876. Type from India.

Paspalum flexuosum Klein ex Presl, Rel. Haenk. 1: 215. 1830. Type from the Philippines.

Paspalum cognatum Steud., Syn. Pl. Glum. 1: 28. 1854. Type from Java.

Paspalum scrobiculatum L. var. *philippinensis* Merr., Philip. Jour. Sci. 1: Suppl. 345. 1906. Type from the Philippines.

Paspalum longifolium Roxb. var. *trichocoleum* Hack., Philip. Jour. Sci. Bot. 3: 167. 1908; Hitchc., Brittonia 2: 121. 1936. Type from the Philippines.

Paspalum scrobiculatum L. var. *longifolium* (Roxb.) Domin, Bibl. Bot. 85: 288. 1915.

Perennial; culms solitary or tufted, rather stout, 80–130 cm. tall; sheaths longer than the internodes, compressed-keeled, glabrous to more or less densely papillose-pilose, especially on the margins; ligule membranous, about 2 mm. long, often with a row of tawny hairs behind it; blades glabrous, firm, flat or folded, as much as 60 cm. long, about 6–9 mm. wide, the margins scabrous; racemes 4–12, about 5–8 cm. long, alternate and rather distant along the slender axis, this glabrous or with a few long hairs in the axils of the racemes; rachis 2–4 mm. wide (usually about 3 mm.), the margins scabrous; spikelets apiculate, paired, 4-rowed, at least in the central part of the raceme, broadly obovate, about 2–2.5 mm. long; glume and sterile lemma equal, 3-nerved, minutely crisp-puberulent to glabrous; fertile lemma brown at maturity.

BRITISH NEW GUINEA: Central Division: Hula, *Brass 521* (GH, US) (damp hollows in coast sandhills); Western Division: Dagwa, Oriomo River, alt. 40 m., *Brass 5922* (A, US) (plentiful in pond shallows); Daru Island, *Brass 6341* (A, US) (plentifully scattered through grass swamps in savannah forest). NORTHEAST NEW GUINEA: Morobe District: Near Kajabit Mission, *Clemens 10706* (A, US).

Tropical Asia, the Philippines, to New Guinea.

Apparently closely related to *Paspalum orbiculare,* with which it seems to intergrade. In general it is distinguishable by the more numerous racemes with 4-rowed, apiculate spikelets, and longer leaves. Most specimens of *P. longifolium* have pubescent spikelets, but all gradations may be found from those densely crisp-puberulent, through those only sparsely so, to specimens which are completely glabrous. Probably the most reliable character is the apiculate spikelet.

15. Setaria Beauv.

Setaria Beauv., Ess. Agrost. 51. *pl. 13, fig. 3.* 1812. nom. conserv. (non Archarius 1789, nec Michx. 1803).

Chaetochloa Scribn., U. S. Dept. Agric. Div. Agrost. Bull. 4: 38. 1897.

Spikelets dorsally compressed, elliptic or lanceolate, solitary or clustered, some or all subtended by one to several bristles (sterile branches), articulate on short discoid-tipped pedicels and falling free from the bristles; first glume broad, usually less than half the length of the spikelet, 3–5-nerved; second glume and sterile lemma equal or the former shorter, 5–7-nerved; fertile lemma indurate, smooth or prominently transversely rugose, the margins inrolled. Annuals or perennials with narrow, usually spikelike or rarely open panicles.

TYPE SPECIES: *Setaria viridis* (L.) Beauv. (*Panicum viride* L.).

KEY TO THE SPECIES

1. Panicle open; bristles single, below only part of the spikelets; leaves broad, plicate.. .....1. *S. palmaefolia.*
1. Panicle densely cylindric or more or less lobed; bristles few to several, below all the spikelets; leaves not plicate.
   2. Bristles below each spikelet numerous, at least more than 5; spikelets solitary, or sometimes with a rudimentary second, on the panicle branches.
      3. First glume acuminate; second glume as long as the spikelet or one-fourth shorter.....5. *S. surgens.*
      3. First glume acute or obtuse; second glume not more than two-thirds as long as the spikelet.
         4. Spikelets 2–2.2 mm. long; second glume half as long as the spikelet; sterile lemma strongly nerved.....4. *S. pallide-fusca.*
         4. Spikelets 2.6–3 mm. long; second glume more than half as long as the spikelet; sterile lemma faintly nerved.....6. *S. montana.*
   2. Bristles below each spikelet 1–3; spikelets usually 3 or more (rarely single on depauperate plants) on the panicle branches.
      5. Fertile floret falling free from the glumes and sterile lemma.....3. *S. italica.*
      5. Fertile floret falling together with the glumes and sterile lemma..... .....2. *S. viridis.*

1. **Setaria palmaefolia** (Koenig) Stapf, Jour. Linn. Soc. Bot. **42**: 186. 1914; Hitchc., Brittonia 2: 124. 1936.

   Panicum palmaefolium Koenig, Naturf. 23: 208. 1788. Type from Siam.

   Panicum palmifolium Willd. ex Poir. in Lam., Encycl. Suppl. 4: 282. 1816. Based on *P. plicatum* Willd., Enum. Hort. Berol. 2: 1033. 1809 (non Lam. 1791). Type from India.

   Panicum nervosum Roxb., Hort. Beng. 8. 1814, nomen, Fl. Ind. 1: 314. 1820, descr. (non Lam. 1798). Type from Nepal.

   Panicum neurodes Schult., Mant. 2: 228. 1824. Based on *P. nervosum* Roxb.

   Panicum sulcatum sensu K. Schum., Notizbl. Bot. Gart. Berlin 2: 93. 1898.

   Chaetochloa palmifolia (Willd. ex Poir.) Hitchc. and Chase, Contr. U. S. Nat. Herb. 18: 348. 1917; Hitchc., Contr. U. S. Nat. Herb. **22**: 161–162. *fig. 38.* 1920.

Perennial; culms erect, caespitose or with short rhizomes, 60–200 cm. tall; sheaths usually overlapping, rather loose, keeled, papillose-hispid or glabrous; ligule a dense ring of hairs 1.5–2 mm. long; blades scabrous, often pubescent below, as much as 40 cm. long and 6.5 cm. wide, strongly plicate, acuminate, narrowed to a petiole-like base; panicle loose and open, as much as 40 cm. long; the branches ascending or spreading, the lower somewhat distant, as much as 15 cm. long, the spikelets crowded on short branchlets appressed along the main branches, the bristles 5–15 mm. long, sometimes short and inconspicuous; spikelets 3–4 mm. long, lanceolate, acute, the margins of the glumes and sterile lemma more or less hyaline; first glume 3-nerved, ovate, acute or obtuse, one-third to half

the length of the spikelet; second glume 5-nerved, half to nearly as long as the spikelet, the apex acute; sterile lemma equaling or slightly exceeding the fertile, 5-nerved, acuminate, and with a short incurved point, enclosing a hyaline palea; fertile lemma faintly transversely rugose.

BRITISH NEW GUINEA: Central Division: Vanapa Valley, Urunu, alt. 1900 m., *Brass 4792* (GH, US) (common on damp stream banks on deforested land); Kanosia, *Carr 11355* (NY) (banks of river); Goodenough Island: Malauna Creek, about 1 mile west of Haiwali, *Burcham 133* (US). NORTHEAST NEW GUINEA: Morobe District: Dreger Harbor, near Finschhafen, *Reeder 885* (A, US) (along roadside); Sepik River, *Herre 313* (NY). NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11471* (A, US) (occasionally associated with *Imperata* on formerly cultivated slopes); 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13263* (A, US) (rain-forest; common in open seral growths on river flood plain); Nassau Region, Explorat Biv., alt. about 1200 m., *Docters van Leeuwen 10814* (GH). SOLOMON ISLANDS: Bougainville: *Kajewski 1779* (GH).

2. **Setaria viridis** (L.) Beauv., Ess. Agrost. 51, 171, 178. *pl. 13, fig. 3.* 1812; Hack., Denkschr. Akad. Wiss. Math.-Naturw. (Wien) 89: 495. 1913.

Panicum viride L., Syst. Nat. ed. 10. 2: 870. 1759; Trin., Sp. Gram. Ic. 2: *pl. 203.* 1829. Type from Europe.[15]

Chaetochloa viridis (L.) Scribn., U. S. Dept. Agric. Div. Agrost. Bull. 4: 39. 1897.

Annual; culms tufted or solitary, erect or geniculate at base, 30–60 (10–100) cm. tall; sheaths rather loose, glabrous or papillose-hispid, ciliate on the margins and sometimes slightly ciliate on the collar; ligule short, densely ciliate; blades flat, 5–30 cm. long, 2–18 mm. wide, scabrous, especially above; panicle densely cylindric, erect or nodding, 5–10 (2–20) cm. long, the axis and branches pubescent; branches variable in length, bearing 3–6 spikelets (sometimes very short and reduced to 2 or 3 spikelets, or in giant specimens the branches 1 cm. or more long and very densely flowered); bristles 1–3 below each spikelet, mostly 4–12 mm. long, green or yellowish, or sometimes purple; spikelets 2–2.5 mm. long, 0.8–1 mm. wide, elliptical, usually obtuse; first glume 3-nerved, ovate, about one-third as long as the spikelet; second glume 5-nerved, equaling the spikelet or slightly shorter; sterile lemma 5-nerved, enclosing a small narrow palea; sterile lemma oblong, obtuse, obscurely rugose.

A cosmopolitan weedy species.

Although no specimens from New Guinea have been seen, this species is included since it was reported from New Britain by Hackel (25, p. 495) and is to be expected from New Guinea.

3. **Setaria italica** (L.) Beauv., Ess. Agrost. 51, 170, 178. 1812.

Panicum italicum L., Sp. Pl. 56. 1753; Trin., Sp. Gram. Ic. 2: *pl. 198.* 1829. Type from India.

Pennisetum italicum (L.) R. Br., Prodr. Fl. Nov. Holl. 1: 195. 1810.

Chaetochloa italica (L.) Scribn., U. S. Dept. Agric. Div. Agrost. Bull. 4: 39. 1897.

A cultivated form of *Setaria viridis;* culms usually stout, 30–150 cm. tall; blades as much as 45 cm. long and 2.5 cm. wide; panicles 10–30 cm. long, usually strongly lobate and drooping, sometimes as much as 3 cm. thick; bristles from scarcely as long as the spikelets to 3 or 4 times as long; spikelets 2–3 mm. long, the fertile floret smooth or nearly so, tawny to red, brown, or black at maturity, falling away from the glumes and sterile

[15] See Hitchcock, Contr. U. S. Nat. Herb. 22: 187. 1920.

lemma. The plants often propagate themselves in fields and waste places and then tend to revert to a more primitive form. Such plants are often difficult to distinguish from *S. viridis*, since the disarticulation of the "fruit" is often evident only at maturity, and even then is often not well marked in the uncultivated plants.

NETHERLANDS NEW GUINEA: Biak Island: Bosnek Bay, *M. E. Britton 22* (A).

Widely cultivated for its grains in many parts of the world; also escaped and appearing more or less as a waif in waste places.

F. T. Hubbard (Am. Jour. Bot. 2: 187. 1915) proposes three subspecies based on the color of the mature "fruit." The cited specimen apparently belongs to subspecies *stramineofructa* F. T. Hubb.

4. **Setaria pallide-fusca** (Schum.) Stapf and C. E. Hubb., Kew Bull. 1930: 259. (July) 1930, in Prain, Fl. Trop. Afr. 9: 815. (Aug.) 1930; C. E. Hubb. and Vaughan, Grass. Maurit. and Rodriguez 68. *fig. 11a*. 1940.

Panicum pallide-fuscum Schum., Beskr. Guin. Pl. 78. 1827. Type from West Africa.

Annual; culms more or less compressed, erect or ascending (sometimes sprawling), 30–100 (rarely to 150) cm. tall, branching below, often more or less decumbent and rooting from the lower nodes, more or less pubescent just below the panicle, otherwise glabrous; nodes glabrous, dark brown; sheaths glabrous, rather loose, compressed-keeled, the margins scarious; ligule a ciliate membrane about 1 mm. long; blades flat or folded (sometimes involute), 10–20 (rarely to 40) cm. long, 3–8 mm. wide, glabrous or more or less pilose above near the ligule; panicle long-exserted, dense, spikelike, evenly cylindric, 5–8 (3–15) cm. long, the rachis and branchlets densely pubescent; bristles numerous, 2–3 times the length of the spikelets; spikelets elliptical, 2–2.2 mm. long, about 1 mm. wide; first glume 3-nerved, about 0.8 mm. long, obtuse to acute; second glume 5-nerved, about half as long as the spikelet, obtuse; sterile lemma prominently 5-nerved, enclosing a well-developed palea and rarely a staminate flower; fertile lemma 2 mm. or less long, transversely rugose, rounded or slightly angled on the back, the apex acute, often very slightly mucronate.

BRITISH NEW GUINEA: Central Division: Mafulu, alt. 1250 m., *Brass 5482* (GH, US) (roadsides and sometimes on artificial grassland); Western Division: Wuroi, Oriomo River, alt. 10–30 m., *Brass 5740* (GH, US); Daru Island, *Brass 6270* (A, US) (plentiful on damper soils of savannah forests); Lake Daviumbu, Middle Fly River, *Brass 7883* (A, US) (restricted to patches of damper soil in savannahs); Northern Division: About 7 miles northwest of Oro Bay, *Reeder 804* (A, US) (occasional in wet areas); south of Cape Sudest, *Reeder 855* (A, US) (growing thickly along abandoned jeep trail); Goodenough Island: Haiwali, *Burcham 125* (US) (grassy clearing in rain-forest). NORTHEAST NEW GUINEA: Morobe District: Kajabit, Markham Valley, *Clemens 10540J* (US); Finschhafen, *Weinland 357* (US). NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11814* (US) (abundant in abandoned gardens); Waren, 60 miles south of Manokwari, alt. 10 m., *Kanehira and Hatusima 13371* (A) (in open grass-field).

Tropical and South Africa to tropical Asia, northern Australia, and Polynesia.

The cited specimens, though varying considerably in size and habit, are remarkably uniform in spikelet characters. Although the spikelets are slightly smaller than is usual for African specimens of this species, they

seem to differ in no other important respect. *Reeder 855* has a rather unusual habit, being weak-stemmed and sprawling, but in the character of the spikelets it seems identical with the others cited.

Specimens of this species have been referred to *Setaria geniculata* (Lam.) Beauv., a perennial species with larger and broader spikelets, in which the sterile lemma is 7- rather than 5-nerved.

5. **Setaria surgens** Stapf, Kew Bull. 1909: 265. 1909. Type from Netherlands New Guinea.

Perennial, but often flowering the first year and appearing annual; culms caespitose, often geniculate at base, 30–45 cm. tall, fluted above, pubescent below the panicle, otherwise glabrous or scabrous; nodes glabrous, dark brown to black; ligule a row of hairs 0.3–0.5 mm. long; blades flat, often involute in drying, 8–18 cm. long, 2–4 (rarely 5) mm. wide, scabrous on the margins, glabrous beneath, spreading-pilose above, the hairs weak, 2–3 mm. long; panicle spikelike, long-exserted, densely flowered, 3–5 cm. long, the rachis and branchlets pubescent; branches opposite or whorled, the bristles 6–8, about 8–12 mm. long; spikelets obovate-elliptic, solitary, 2.3–2.6 (rarely 3) mm. long; first glume 3-nerved, ovate, acuminate, half to two-thirds as long as the spikelet; second glume ovate, 5-nerved, as long as the spikelet or about one-fourth shorter; sterile lemma equaling the fertile one, 5-nerved, apiculate, enclosing a thin palea as long as the lemma and with two marginal nerves, these sometimes showing through the sterile lemma and making it appear 7-nerved; fertile lemma transversely rugose, broadly angled on the back.

BRITISH NEW GUINEA: Central Division: Hisiu, *Carr 11382* (NY) (open places near sea shore); Western Division: Near Dutch Boundary [Fly River], *MacGregor 11, 13* (US).

Australia and New Guinea.

Closely related to *Setaria apiculata* (Scribn. and Merr.) K. Schum., from Australia, but may be distinguished by its more densely flowered panicles and smaller, differently shaped spikelets, those of *S. apiculata* being broadly ovate and 3–3.5 mm. long, while those of *S. surgens* are obovate-elliptic and about 2.5 mm. long. Both of these species are characterized by an acuminate first glume and apiculate sterile and fertile lemmas.

Although Stapf's original description states that the first glume is "acute to apiculate," a specimen in the U. S. National Herbarium with an acuminate first glume was seen by C. E. Hubbard of Kew, who states that the spikelets agree perfectly with those of a specimen cited by Stapf with the original description of *S. surgens*. The type of *S. surgens* is not at Kew.

6. **Setaria montana** sp. nov. PLATE III.

Perennis? vel annua plerumque 40–80 cm. alta; culmis compressis, adscendentibus ad basin geniculatis, infra paniculam pubescentibus, ceterum glabris; nodis fuscis vel nigrescentibus, eis infra medium culmum saepe ramiferis; vaginis carinatis, glabris, quam internodiis brevioribus, plus minusve laxis, marginibus scariosis; ligula membranacea, ciliata, 0.5–0.8 mm. longa; laminis linearibus, saltem in sicco subinvolutis, 10–20 (raro ad 30) cm. longis, 2–5 mm. latis, subtus glabris, supra scabris et praecipue

prope basin plus minusve pilosis; panicula solitaria, dense spiciformi, 4–10 cm. longa, 5–8 mm. diametro, rhachi et ramis dense pubescentibus, ramis circiter 5 mm. longis; setis circiter 8–10, inaequalibus, usque ad 4–5 (raro ad 8) mm. longis, scabris, ferrugineis vel purpureis; spiculis ellipticis, 2.6–3 mm. longis, circiter 1.3 mm. latis, solitariis vel binatis quarum uno abortivo; gluma prima late ovata, acuta, 1.2–1.4 mm. longa, nervis 3–5, prominulis; gluma secunda late ovata, obtusa, quam spicula circiter tertia parte breviore, 5-nervia, nervis prominulis; lemmate sterili spicula aequante, nervis 3–5, obscuris; lemmate fertili ovata, mucronulata, transverse rugulosa, quam sterili paullo breviore.

BRITISH NEW GUINEA: Central Division: Urunu, Vanapa Valley, alt. 1900 m., *Brass 4788* (A, US) (conspicuous on open grasslands and fallow garden clearings). NORTHEAST NEW GUINEA: Morobe District: Ogeramnang, alt. about 1750 m., *Clemens 4498* (A). NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass 10746* (A, US) (plentiful on a native clearing in the forest; habit ascending and clump-forming; inflorescence reddish-brown); 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11488* (A, TYPE, US) Nov. 1938 (very abundant on old garden lands; habit ascending); Balim River, alt. 1600 m., *Brass 11814* (A) [16] (abundant in abandoned gardens).

In some respects this species suggests the highly variable *Setaria geniculata* (Lam.) Beauv., but it differs in having a more slender panicle, longer and narrower spikelets with faintly 5-nerved rather than prominently 7-nerved sterile lemmas, usually much shorter bristles, and narrower subinvolute rather than flat blades. Comparison may also be made with *S. pallide-fusca*, but that species is definitely an annual with broader blades and smaller spikelets, in which the second glume is only half the length of the spikelets and the sterile lemma is prominently nerved. The cited specimens were all collected at elevations of 1600 meters or more.

16. Pseudoraphis Griff.

Pseudoraphis Griff., Not. ad Pl. Asiat. 3: 29. 1851; Pilger, Notizbl. Bot. Gart. Berlin 10: 209. 1928.

Spikelets lanceolate, attenuate, dorsally compressed, 2-flowered, the lower staminate, the upper pistillate, short-pediceled along the slender simple branches of the panicle, the back of the fertile lemma turned toward it; the branches produced beyond the spikelets into a slender bristle and finally disarticulating from the main axis; first glume nerveless, hyaline; second glume attentuate, 5–many-nerved; sterile lemma shorter than the second glume, acuminate, with a nerveless palea and a staminate flower; fertile floret pistillate, much shorter than the sterile lemma, membranous or very slightly indurated; caryopsis obovate-oblong, exposed beyond the lemma and palea at maturity. Aquatic or marsh perennials with simple contracted or narrow panicles, the branches stiffly ascending.

TYPE SPECIES: *Pseudoraphis Brunoniana* Griff.

1. **Pseudoraphis squarrosa** (L. f.) Chase, Jour. Arnold Arb. 20: 313. 1939.
   Andropogon squarrosus L. f., Suppl. Pl. 433. 1781. Type from Ceylon.
   Panicum asperum Koenig, Naturf. 23: 209. 1788 (non Lam. 1778). Type from East Indies.

[16] This collection consisted of a mixture, and the specimen under this number at the U. S. National Herbarium is *Setaria pallide-fusca*.

Chamaeraphis aspera (Koenig) Nees in Wall. Cat. No. 8679. 1849.
Pseudoraphis aspera (Koenig) Pilger, Notizbl. Bot. Gart. Berlin 10: 210. 1928; Blatter and McCann, Imp. Council Agric. Res. Sci. Monogr. 5: *pl. 109*. 1935.

Culms prostrate, rooting from the lower nodes, as much as 3–4 meters long, the ascending flowering portion 30–70 cm. tall, more or less branched, glabrous except for the more or less pubescent nodes; sheaths glabrous, rather loose, often prolonged into two sharp auricles, one on either side of the ligule and equal to it; ligule about 1 mm. long, membranous, erose; blades flat to involute, lanceolate-linear, 3–6 cm. long, 2–4 mm. wide, scabrous on the margins, the base often narrowed into a distinct petiole about 1 mm. long; panicle 6–14 cm. long, the slender scabrous branches several-flowered, stiffly ascending, the lowermost as much as 6 cm. long; spikelets lanceolate, acuminate, 5–7 mm. long, solitary, on pedicels about 0.5 mm. long; first glume truncate or rounded, hyaline, about 0.5 mm. long; second glume 5–7 mm. long, acuminate, scabrous to hispid on the nerves, the hairs sometimes tuberculate-based; sterile lemma somewhat shorter than the second glume, similar to it or lighter in color and with the nerves obscure, acuminate, glabrous or somewhat scabrous, enclosing a palea and a staminate flower; fertile lemma pistillate, 1.6–1.8 mm. long, membranous; mature caryopsis much exceeding the lemma and palea.

BRITISH NEW GUINEA: Western Division: Lake Daviumbu, Middle Fly River, *Brass 7600* (A, US) (rooting in shallows of swamps); Penzara, between Morehead and Wassi Kussa Rivers, *Brass 8470* (A, US) (in shallows of a permanent water hole).

India to the East Indies, Philippines, and New Guinea.

17. Pennisetum Rich.

Pennisetum Rich. in Pers., Syn. Pl. 1: 72. 1805.
Penicillaria Willd., Enum. Pl. Hort. Berol. 2: 1036. 1809.
Gymnothrix Beauv., Ess. Agrost. 59. *pl. 13, fig. 6*. 1812.

Spikelets lanceolate, sessile or short-pediceled, solitary or two to three together surrounded by an involucre of bristles (sterile branchlets), the fascicles subsessile or short-peduncled, usually crowded on a common axis and falling entire with the spikelets enclosed; glumes shorter than the spikelet, unequal, the first smaller, thin, usually nerveless, the second 1-nerved; sterile lemma few to several-nerved, acute or awn-pointed, enclosing a palea and often a staminate flower; fertile lemma equaling the sterile or shorter, smooth, chartaceous, rounded on the back, the margins thin, flat, enclosing a similar palea. Annuals or perennials with usually flat blades and dense spikelike panicles.

TYPE SPECIES: *Pennisetum typhoideum* Rich. = *P. spicatum* (L.) Koernicke (*Holcus spicatus* L.).

1. **Pennisetum macrostachyum** (Brongn.) Trin., Mém. Acad. St. Petersb. VI. Sci. Nat. 1: 177. 1834; F. Muell., Vict. Nat. 1: 168. 1884.
Gymnothrix macrostachys Brongn. in Duperry, Bot. Voy. Coquille 2 (2): 104. *pl. 11*. 1831. Type from the Moluccas.

Culms erect, glabrous, 2–3 meters tall, 1–2 cm. in diameter near the base, freely branching; sheaths usually overlapping, rather loose, somewhat keeled toward the summit; ligule membranous, 0.2 mm. long or less; blades flat, 20–40 cm. long, 1–3 cm. wide, glabrous or scabrous, the midrib rather prominent beneath; panicle nodding, 15–30 cm. long; spikelets

solitary, 5–6 mm. long, subtended by fine, minutely antrorsely scabrous hair-like bristles as much as 3 cm. long; glumes hyaline, the first nerveless, about half as long as the second, this 2.5–3 mm. long, 1-nerved; sterile and fertile lemma about equal, the sterile 5-nerved, with sometimes obscure lateral nerves, acuminate or short awn-tipped at apex, empty or enclosing a palea and sometimes a staminate flower; fertile lemma chartaceous-indurate, smooth, the apex acuminate or short awn-tipped, the margins hyaline, not inrolled; palea scaberulous on the upper half.

BRITISH NEW GUINEA: Central Division: Laloki River, *Brass 538* (GH, US), *Brass 3610* (A, US) (savannah gullies or in shelters of rocks); Mafulu, alt. 1250 m., *Brass 5513* (A, US) (forms small thickets in regrowth brush); Veiya, *Carr 11658* (US); Western Division: Daru Island, *Brass 6397* (A, US) (gregarious in thickets 2–3.5 meters high). NORTHEAST NEW GUINEA: Morobe District: Near Kajabit Mission, *Clemens 40793* (US); Wantoat, *Clemens 41172* (US); Finschhafen, *Lauterbach 24* (US). NETHERLANDS NEW GUINEA: Hollandia and vicinity, alt. 10 m., *Brass 8893* (A, US) (forming thickets 2–3 meters high on dry gravel beds in river); Balim River, alt. 1600 m., *Brass 11777* (A, US) (abundant on dry stony soil); Rouffaer River, alt. about 100 m., *Docters van Leeuwen 9727* (GH). NEW BRITAIN: *Naumann* in 1875 (US). SOLOMON ISLANDS: Bougainville: *Kajewski 2245* (GH); Ysabel: Tinibuli, *Herre 132* (NY).

East Indies and the Philippines to New Guinea and Australia.

18. Cenchrus L.

Cenchrus L., Sp. Pl. 1049. 1753.

Spikelets sessile, one to several together, permanently enclosed in a bristly or spiny involucre or bur, composed of more or less coalesced sterile branchlets; burs sessile or nearly so on a slender axis, its apex produced into a short point beyond the uppermost bur, the burs falling entire, the grains germinating within them; spikelets lanceolate; glumes membranous, the first 1-nerved, narrow, sometimes wanting, the second 3–5-nerved, usually shorter than the spikelet; sterile lemma about equal to the fertile one, membranous, 3–5-nerved, enclosing a well-developed palea and often a staminate flower; fertile lemma indurate, membranous near the tip, the margins clasping the palea but not inrolled. Annuals (ours) or perennials with flat blades and spikelike racemes of burs, the burs readily deciduous.

TYPE SPECIES: *Cenchrus echinatus* L.

KEY TO THE SPECIES

1. Burs not densely crowded in the racemes; lobes of the involucre not interlocking; first glume present ..... 1. *C. echinatus.*
1. Burs densely crowded; lobes of the involucre interlocking; first glume wanting .... 2. *C. Brownii.*

1. **Cenchrus echinatus** L., Sp. Pl. 1050. 1753; Chase, Contr. U. S. Nat. Herb. **22**: 58–62. *fig. 12.* 1920. Type probably from Jamaica.

Annual; culms somewhat compressed, glabrous, or scabrous below the inflorescence, ascending from a geniculate or decumbent base and usually branching and rooting from the base and lower nodes, 25–60 (sometimes to 100) cm. long; sheaths usually overlapping, glabrous or more or less pubescent, especially on the margins toward the summit, loose, somewhat

keeled; ligule ciliate, about 1 mm. long; blades flat, 6–20 cm. long, 3–8 mm. wide, scabrous or sparsely pilose on the upper surface; racemes often rather long-exserted in age, 3–10 cm. long, less dense than those of *C. Brownii,* the axis scabrous; burs truncate at base, the body 4–7 mm. high, as broad or broader, pubescent, the outer slender bristles usually less numerous than in *C. Brownii,* the inner bristles stout, usually broadened at the base and equaling the lobes of the body or shorter; lobes of the body commonly 10, often pilose, erect or bent inward, sometimes one or two of the lobes inflexed; spikelets 3–6, lanceolate, acuminate, about equaling the lobes or shorter, 4.5–6 mm. long; first glume narrow, 1-nerved; second glume two-thirds to three-fourths as long as the subequal sterile and fertile lemmas.

BRITISH NEW GUINEA: Gulf Division: Kanosia, *Carr 11180* (NY) (open savannah land). NORTHEAST NEW GUINEA: Morobe District: 4 miles south of Langemak Bay (near Finschhafen), *Sawyer 82* (A, US).

Tropics of both hemispheres.

2. **Cenchrus Brownii** Roem. and Schult., Syst. Veg. 2: 258. 1817; Chase, Jour. Arnold Arb. 20: 313. 1939. Based on *Cenchrus inflexus* R. Br.

Cenchrus inflexus R. Br., Prod. Fl. Nov. Holl. 1: 195. 1810 (non Poir. 1804). Type from Australia.

Cenchrus viridis Spreng., Syst. Veg. 1: 301. 1825; Chase, Contr. U. S. Nat. Herb. 22: 57. *fig. 11.* 1920. Type from Guadeloupe.

Annual; culms glabrous or scabrous below the inflorescence only, often rather robust, 30–100 cm. tall, erect or ascending from a more or less geniculate base, sparingly branching from the base or lower nodes; sheaths glabrous, rather loose, keeled, overlapping or sometimes shorter than the internodes; ligule a row of hairs scarcely 1 mm. long; blades flat, 10–30 cm. long, 6–15 mm. wide, the upper surface and margins scabrous; racemes short-exserted, 5–12 cm. long, dense; burs depressed-globose, the body about 4 mm. high and as broad or broader, puberulent, tawny, the outer bristles very slender, numerous, crowded toward the base, the inner stouter, about equal to or longer than the body and the spikelet, retrorsely scabrous; lobes of the body 6–8, interlocking at maturity; spikelets about 3 per bur, lanceolate, acuminate, 4–5 mm. long; first glume wanting, otherwise spikelets similar to those of *C. echinatus.*

BRITISH NEW GUINEA: *MacGregor 5* (US); Western Division: Daru Island, *Brass 6395* (A, US) (plantation weed, not plentiful).

Indo-China and the East Indies to the Philippines, New Guinea, and Australia. Also in tropical America.

Closely related to *Cenchrus echinatus,* but differing in its more erect habit, usually broader blades, usually smaller burs with fewer spikelets and interlocking lobes, and in the absence of a first glume. Many collections reported from this region as *C. echinatus* are probably *C. Brownii,* which is much more common. *Cenchrus echinatus* is a native of the New World and has probably been introduced into New Guinea.

19. Isachne R. Br.

Isachne R. Br., Prodr. Fl. Nov. Holl. 1: 196. 1810.

Spikelets subglobose or ovoid, 2-flowered; glumes membranous, subequal, as long as the florets or slightly shorter (rarely exceeding the florets),

tardily deciduous, leaving the naked florets attached to the clavate pedicels; florets similar, indurate and both perfecting fruits, or the lower staminate only, usually larger than the upper and of a thinner texture, the two florets remaining attached by the minute rachilla joint and falling together. Annuals or perennials with flat blades and open or contracted panicles.

TYPE SPECIES: *Isachne australis* R. Br. = *I. globosa* (Thunb.) Kuntze.

KEY TO THE SPECIES

1. Lower floret staminate, not indurate, usually more flattened and larger than the upper.
   2. Upper floret distinctly pubescent; panicle branches with glandular bands.
      3. Spikelets 1.2–1.5 mm. long; lower floret grooved on the back..10. *I. miliacea.*
      3. Spikelets 2–3 mm. long; lower floret rounded on the back.....11. *I. globosa.*
   2. Both florets glabrous or essentially so; panicle branches without glandular bands.. .....9. *I. Brassii.*
1. Lower floret mostly perfect, sometimes slightly larger than the upper, but both florets of a similar texture.
   4. Glumes 2.5–3.5 mm. long, appressed-hispid, considerably exceeding the florets.. .....4. *I. Schmidtii.*
   4. Glumes not more than 2 mm. long, about equaling or slightly exceeding the florets.
      5. Plants low, creeping, the upright branches not more than 15 cm. tall; blades 1.5 cm. long or less; panicles contracted, less than 2 cm. long.
         6. Spikelets 1–1.5 mm. long; plants 2–6 cm. tall.....5. *I. Myosotis.*
         6. Spikelets 1.8–2 mm. long; plants 10–15 cm. tall.....6. *I. pauciflora.*
      5. Plants not as above; panicle 2–30 cm. long, more or less open.
         7. Sheaths less than 1 cm. long, mostly tuberculate-hispid, the internodes 3–8 times as long; ligule wanting.....3. *I. confusa.*
      7. Sheaths much longer in proportion to the internodes; ligule a ring of hairs.
         8. Culms rigid, erect, ascending, or sometimes sprawling.
            9. Culms 65–150 cm. tall; panicle branches ascending or spreading; rachilla terete.
               10. Panicle axis, branches, and pedicels smooth or nearly so; panicle 15–25 cm. long.....1. *I. albens.*
               10. Panicle axis, branches and pedicels distinctly scabrous; panicle mostly 8–15 cm. long.....2. *I. arfakensis.*
            9. Culms 30–45 cm. tall; panicle branches stiffly erect; rachilla flattened.. .....7. *I. obtecta.*
         8. Culms weak, decumbent at base and rooting from the lower nodes.
            11. Florets glossy, the rachilla flattened.....9. *I. Brassii.*
            11. Florets papillose-roughened or pubescent, the rachilla terete..... .....8. *I. villosa.*

1. **Isachne albens** Trin., Sp. Gram. Ic. 1: *pl. 85.* 1827; Chase, Jour. Arnold Arb. 24: 87. 1943. Type from India.

Panicum albens (Trin.) Steud., Syn. Pl. Glum. 1: 96. 1854.

Isachne stricta Elmer, Leaflets Philip. Bot. 2: 463. 1908; Chase, Jour. Arnold Arb. 24: 88. 1943. Type from the Philippines.

Isachne elatiuscula Ohwi, Bot. Mag. (Tokyo) 56: 5. 1942. Type from New Guinea.

Culms rather slender, erect or sprawling, 60–150 cm. tall; sheaths rather loose, the lower shorter than the internodes, the upper often overlapping, more or less ciliate on the margins especially above, the hairs continuous with the ligule, this represented only by a row of hairs about

2 mm. long; blades rather firm, 8–18 cm. long, 5–15 mm. wide, glabrous to scabrous to appressed stiff-pubescent, the margins usually strongly scabrous, often revolute when dry; panicle pyramidal, 15–25 cm. long, the axis and branches smooth or nearly so, the branches ascending or spreading when mature, rather rigid and densely flowered to loosely flowered and more or less lax; spikelets 1.3–1.8 mm. long, subglobose; glumes equal, 7-nerved, equaling the spikelet or slightly shorter, glabrous or more or less hispid toward the tips; florets alike, orbicular to elliptic, obtuse, glabrous or puberulent, the short rachilla terete.

NORTHEAST NEW GUINEA: Morobe District: Yunzaing, alt. about 1300 m., *Clemens 4105* (A, US) (seepage over rock slope); Ogeramnang, alt. 1600–1700 m., *Clemens 4592* (A), *5409, 6958a* (A, US); Samanzing, alt. about 2000 m., *Clemens 9239* (US) (margin of mountain rivulet), *Clemens 10379* (US) (hamlet watercourse, on the bank with *Glyceria*). NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11559* (A, US) (common in open secondary forest; scrambling or in suberect clumps 1–1.5 meters high); Angi, Arfak Mountains, alt. 1900 m., *Kanehira & Hatusima 14019* (type coll. of *I. elatiuscula*, A) (in the forest by Lake Gita).

Indo-Malayan region to New Guinea.

Isachne elatiuscula Ohwi is described as differing from *I. albens* in its firmer and denser panicle. Examination of an isotype (A) shows that the panicle is more dense and the panicle branches more densely flowered than typical *I. albens*. This character does not seem to be reliable, however, when it is seen that there are numerous intergrades between specimens with open panicles and loosely flowered branches and those of the type represented by *I. elatiuscula*.

Clemens 6958a was cited as *Isachne scabrosa* Hook. f. by Chase (18, p. 87).

2. **Isachne arfakensis** Ohwi, Bot. Mag. (Tokyo) 56: 4. 1942. Type from New Guinea.

Culms ascending or sprawling, freely branching, 65–110 cm. tall, scabrous below the inflorescence, otherwise glabrous and smooth; sheaths mostly shorter than the internodes, ciliate on the margins, the hairs continuous with the 2 mm. long ciliate ligule, the sheaths otherwise glabrous or slightly pubescent toward the summit; blades flat, rather firm, 5–15 cm. long, 6–12 mm. wide, seabrous above, more or less appressed-pubescent below, the margins scabrous; panicle 8–20 cm. long, oblong-ovate, the axis and stiffly ascending branches scabrous; spikelets subglobose, 1.5–1.8 mm. long; glumes 7-nerved, equaling the spikelet or the first slightly shorter, obtuse, glabrous or minutely scaberulous, the tips sometimes hispid; florets subequal, glabrous or minutely puberulent, especially on the margins, separated by a very short terete rachilla.

BRITISH NEW GUINEA: Central Division: Mt. Tafa, alt. 2400 m., *Brass 4871* (GH, US) (plentiful on open banks of a small stream flowing over landslide debris). NORTHEAST NEW GUINEA: Morobe District: Samanzing, alt. 1800 m., *Clemens 9209* (US) (landslide near little waterfall). NETHERLANDS NEW GUINEA: Angi, Arfak Mountains, alt. 1900 m., *Kanehira & Hatusima 13588* (TYPE FRAGMENT, A) (in open marsh by Lake Gita).

Known only from New Guinea.

In the original description, Ohwi describes this species as having blades

5–8 cm. long, 6–7 mm. wide, and a panicle about 8 cm. long. The Brass specimen (at US) is a good match for the type except that the blades are up to 9 mm. wide and the panicles are 10–14 cm. long. A duplicate of this same Brass collection (at GH) has blades more than 15 cm. long and 12 mm. wide. The panicle is 20 cm. long. In all other respects these specimens agree well with each other and with Ohwi's original description and a fragment of the type (at A). *Brass 4817* [*4871*] was reported as *Isachne pangerangensis* Zoll. and Mor. by Hitchcock (35, p. 123) and as *I. scabrosa* Hook. f. by Chase (18, p. 87).

3. **Isachne confusa** Ohwi, Tokyo Sci. Mus. Bull. 18: 14. 1947. Type from Sumatra.
Isachne firmula sensu Hitchc., Brittonia 2: 123. 1936.
Isachne Rhignon (Steud.) Ohwi, Bot. Mag. (Tokyo) 55: 541. 1941, excl. syn.

Culms erect or spreading, 15–60 (commonly about 30) cm. tall, simple below, branching from the upper nodes, the internodes elongate; sheaths much shorter than the internodes, about 0.5 cm. long, glabrous to tuberculate-hispid; ligule wanting; blades lanceolate, firm, prominently nerved, usually scabrous above, the margin often pectinate, 10–20 mm. long, 4–8 mm. wide; panicle 2–4 cm. long, 1.5–3 cm. wide, the branches stiffly divergent, some of them with glandular bands; pedicels rather stout, clavate, these and the panicle branches glabrous; spikelets about 1.3 mm. long, the obtuse hispid glumes barely equaling the florets; florets alike, both perfect, pale to tawny, granular-roughened, about 1 mm. long.

British New Guinea: Western Division: Wuroi, Oriomo River, *Brass 5854* (GH, US) (small area of tea tree marsh on savannah); Lake Daviumbu, Middle Fly River, *Brass 7832* (A, US) (scattered through coarser grass on wet plain).

India, China, Philippines, Netherlands Indies to New Guinea.

4. **Isachne Schmidtii** Hack., Bot. Tidsskrift 24: 97. 1901. Type from Siam.
Isachne semitalis Ridl., Fl. Malay Peninsula 5: 237. 1925. Type from Malay Peninsula.

Annual; culms creeping, the ascending flowering branches 5–20 cm. tall; sheaths overlapping or slightly shorter than the internodes, glabrous except for the ciliate margins, the hairs on the upper part stiff and continuous with the ciliate ligule, this about 1 mm. long; blades lanceolate to ovate-lanceolate, 1.5–5 cm. long, 5–9 mm. wide, glabrous to more or less scabrous-hispid especially below, the margins prominently scabrous; panicle contracted to rather open, 1–4 cm. long, the scabrous, angled branches stiffly ascending; spikelets 2.5–3.5 mm. long on clavate pedicels; glumes rigid-hispid, ovate, exceeding the florets, subequal, the lower slightly longer; florets similar, oval or elliptic, obtuse, one-fourth to one-third (rarely half) shorter than the glumes, glabrous or the lemmas slightly hispid on the inrolled margins.

Solomon Islands: Ysabel: Tiratona, *Brass 3405* (GH) (shady pathways in mountain forests).

Siam, Malay Peninsula, Philippines to New Guinea.

Hackel described the species as only about 6 cm. tall and with the glumes twice as long as the florets. A specimen in the National Herbarium (obtained from the Hackel Herbarium in Vienna by Agnes Chase and labeled *Isachne Schmidtii* in Hackel's handwriting) is a tiny plant only about 4.5 cm. tall and with a small panicle of only 4 spikelets. Except

for its size, the plant agrees in all respects with the cited specimen and with others like it from the Malay Peninsula and the Philippines. The species seems well characterized by its rather large spikelets with pointed hispid glumes noticeably longer than the florets.

5. **Isachne Myosotis** Nees, Jour. Bot. Kew Misc. 2: 98. 1850; White, Proc. Roy. Soc. Queensl. 34: 16. 1923. Type from the Philippines.
Panicum Myosotis (Nees) Steud., Syn. Pl. Glum. 1: 96. 1854.
Isachne grisea K. Schum. in K. Schum. and Lauterb., Nachtr. Fl. Deutsch.Schutzgeb. Südsee 57. 1905; Ohwi, Bot. Mag. (Tokyo) 56: 4. 1942. Type from Northeast New Guinea.
Isachne micrantha Merr., Philip. Jour. Sci. Bot. 5: 168. 1910; Chase, Jour. Arnold Arb. 24: 87. 1943. Type from the Philippines.

Low annual; culms freely branching, more or less tufted or creeping and forming mats, the flowering branches 2–6 cm. tall; sheaths overlapping, sparsely to densely pilose, the hairs sometimes tuberculate-based; ligule a row of hairs about 1 mm. long continuous with the ciliate margins of the sheaths; blades ovate to ovate-lanceolate, 5–15 cm. long, 2–4 mm. wide, densely pubescent to papillose-pilose, the hairs rarely somewhat appressed; panicle exserted, few-flowered, 7–16 mm. long, the branches usually strict, glabrous; spikelets 1–1.5 mm. long, subglobose when mature, the glumes similar, about equaling the spikelet, obtuse, subglabrous to rather densely hispid (usually with a few stiff hairs at least toward the tips); florets similar in appearance, about 1 mm. long or slightly more, more or less densely puberulent.

BRITISH NEW GUINEA: Central Division: Murray Pass, Wharton Range, alt. 2840 m., *Brass 4642* (GH, US) (appearing early on burnt grasslands); Rouna, *Carr 12412* (NY) (seepage point above south bank of Laloki River); Nauro–Elobi Divide, *Carr 12971* (US). NORTHEAST NEW GUINEA: Morobe District: Sattelberg, alt. about 90 m., *Clemens 312* (A, US); Sarawaket, alt. about 250 m., *Clemens 6097* (A); Wantoat, alt. about 100 m., *Clemens 40885* (US). NETHERLANDS NEW GUINEA: Lake Habbema, alt. 3225 m., *Brass 9556* (A, US) (locally plentiful on open boggy ground); 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass 10704* (A) (plentiful on native clearing in forest); Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11583* (A, US) (abundant in native gardens); 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13201* (A, US) (matted on flood washed rocks on river bank); Nassau Region, Explorat Biv., alt. about 1200 m., *Docters van Leeuwen 10787* (GH).

Philippines and New Guinea.

The type specimen of *Isachne Myosotis* (fragment at US) has spikelets 1.2–1.5 mm. long, with glumes prominently hispid. The type of *I. micrantha* (US) has spikelets 1–1.3 (rarely 1.5) mm. long, glumes subglabrous or with only a few hairs near the apex, and the lemmas perhaps slightly more hairy than is usual for *I. Myosotis*. In other respects they are very similar, having the same characteristic habit and foliage. No type material of *I. grisea* was available for comparison, but from the description and study of material from near the type locality, it seems evident that it is merely a synonym of *I. Myosotis*.

Carr 12971 is a somewhat taller plant than usual, but the culms are very slender and the blades thin. It is probably a shade form and a note on the label states "path in forest."

Brass 4642 was cited as *Isachne pauciflora* by Hitchcock (35, p. 123).

6. **Isachne pauciflora** Hack., (Philip.) Bur. Govt. Lab. Bull. 35: 80. 1906.
Type from the Philippines.

Aquatic or semi-aquatic; culms weak, rooting below, the flowering branches 10–15 cm. long, glabrous; sheaths rather loose, about half as long as the internodes, more or less densely papillose-hirsute, especially below, the margins ciliate and continuous with the ligule, this about 1 mm. long; blades ovate-lanceolate, acute, 1–1.5 cm. long, about 4 mm. wide, subglabrous or more or less papillose-pilose, the hairs sometimes appressed, the margins scabrous; panicle few-flowered, strict, contracted, about 1.5 cm. long, the rachis and stiff branches glabrous; spikelets 1.8–2 mm. long; glumes equaling the spikelet, obtuse or appearing apiculate by the inrolling of the margins in drying, more or less densely hispid especially toward the tips; florets equal or nearly so, broadly oval, obtuse, densely puberulent, 1.5–1.8 mm. long.

BRITISH NEW GUINEA: Base of Rouna Falls, *Carr 12362* (NY US) (on rocks exposed to continual sprays).

Philippines and New Guinea.

Similar to *Isachne Myosotis* and perhaps not distinct from that species. The only noticeable differences are the elongated culms with sheaths about half as long as the internodes, and the slightly larger spikelets. The cited specimen compares favorably with a type duplicate (at US).

7. **Isachne obtecta** sp. nov. PLATE IV.

Perennis 30–45 cm. alta; culmis caespitosis, glabris, suberectis vel adscendentibus, circiter 1 mm. diametro; nodis glabris, eis infra medium culmi saepe ramiferis; vaginis glabris quam internodiis brevioribus, marginibus ciliatis; ligula ad lineam ciliatam 2–3 mm. longa reducta; laminis lanceolato-linearibus, 2–6 cm. longis, 3–6 mm. latis, acutis, subcordatis, praecipue subtus plus minusve villosis, supra saepe pilis paucis adspersis, marginibus scabris; panicula longe exserta, 5–8 cm. longa, contracta, ramis rigidis, erectis, floribus confertis; rhachi ramisque teretibus, glabris vel sub lente minute scaberulis; pedicellis clavatis; spiculis glabris, 1.5 mm. longis; glumis aequalibus, ellipticis vel plus minusve obovatis, nervis obscuris, circiter 7, marginibus scariosis, paene flosculas obtegentibus; flosculis aequalibus et fructiferis, ellipticis, nitidis, rhachilla complanata junctis, floscula infima interdum paulum dorso-complanata.

BRITISH NEW GUINEA: Western Division: Palmer River, 2 miles below junction with Black River, alt. 100 m., *Brass 7242* (A, TYPE, US) July, 1936 (common in native gardens).

In some respects this species suggests *Isachne Brassii*, but it is readily distinguished by the more upright firmer culms, somewhat villous blades, the much contracted panicle, and the slightly smaller spikelets with glumes almost completely covering the florets. The florets, moreover, are of almost exactly the same size and the tip of the upper is borne slightly above the lower. In *I. Brassii* the tips of the florets are borne at the same height and the upper floret is smaller and more convex on the back. The new species may also be compared with *I. villosa*, but that species has papillose-roughened or pubescent florets which are joined by a terete rachilla.

The specific epithet refers to the fact that the florets are almost completely covered by the glumes.

8. **Isachne villosa** (Hitchc.) comb. nov.
Isachne Brassii Hitchc. var. *villosa* Hitchc., Brittonia 2: 123. 1936; Chase, Jour. Arnold Arb. 24: 87. 1943. Type from British New Guinea.

Culms glabrous, branching at base, decumbent and rooting at the lower nodes, the ascending flowering branches 10–40 cm. tall; nodes bearded; sheaths more or less papillose-pilose, often densely so, sometimes only on the upper part, ciliate on the margins, the hairs continuous with the fringe of stiff hairs forming the ligule, this 1–2 mm. long; blades lanceolate, 1.5–10 cm. long, 3–7 mm. wide, more or less villous, usually densely so below; panicle open, 3–12 cm. long, the branches ascending, rather loosely flowered; spikelets 1.2–1.8 mm. long, upright on the pedicels; glumes about equaling the spikelet, elliptic to narrowly obovate, glabrous; florets similar, equal or the upper slightly smaller, separated by a short terete rachilla, both florets of the same texture, papillose-roughened and more or less puberulent, the hairs often rather long and curled; upper floret sometimes slightly more hairy than the lower.

BRITISH NEW GUINEA: Central Division: Mt. Tafa, alt. 2100 m., *Brass 4132* (TYPE COLL., GH, US) (small roadside grass); Borizi, alt. about 1400 m., *Carr 14271* (NY); without precise locality, *MacGregor 50* (US). NORTHEAST NEW GUINEA: Morobe District: Boana, alt. 700–1300 m., *Clemens 41714* (US); Kaile, alt. about 1600 m., *Clemens 4860* (A); Sarawaket, alt. about 1800 m., *Clemens 4956, 5856, 5924* (A). NETHERLANDS NEW GUINEA: 15 km. southwest of Bernhard Camp, Idenburg River, alt. 1500 m., *Brass 12370* (A, US) (rain-forest; on sand in the bed of a small stream); 18 km. southwest of Bernhard Camp, Idenburg River, alt. 2150 m., *Brass 12475* (A, US) (one small clump on an open rock slide).

Philippines, New Guinea.

Related to *Isachne Brassii* Hitchc., but differing in having a terete rather than flattened and obdeltoid rachilla; the florets papillose-roughened and more or less short-pubescent, the sheaths papillose-pilose, and the blades tomentose, at least on the lower surface. This species may also be compared with *I. Beneckii* Hack., but that species has subglobose spikelets with glumes broadly oval and more or less hispid, at least toward the tips.

9. **Isachne Brassii** Hitchc., Proc. Linn. Soc. N. S. Wales 54: 146. 1929, Brittonia 2: 123. 1936; Ohwi, Bot. Mag. (Tokyo) 56: 5. 1942. Type from British New Guinea.

Culms glabrous, branching at base, decumbent and rooting at the lower nodes, the ascending flowering branches 8–50 cm. tall; sheaths glabrous or minutely pubescent, the margins ciliate, the hairs continuous with the fringe of stiff hairs which forms the ligule, this 1–2 mm. long; blades narrowly oblong-lanceolate, 1.5–7 cm. long, 3–8 mm. wide, scabrous on both surfaces and sometimes with a few scattered stiff hairs; panicle elliptic, 3–10 cm. long, open, the branches ascending, the spikelets short-pediceled along the main branches; spikelets 1.5–1.7 mm. long, borne obliquely on the pedicels; glumes about equaling the spikelet, narrowly obovate, more or less hispid especially toward the tips; florets essentially glabrous and more or less glossy, equal in height but the lower larger, often grooved on the back and of a slightly thinner texture, the upper more convex on the back and separated from the lower by a flattened rachilla which is broader at the apex. When seen before the glumes have fallen

the two florets appear similar, as the slight difference in texture is not striking.

BRITISH NEW GUINEA: Gulf Division: Ihu, Vailala River, *Brass 1018* (TYPE COLL., GH, US) (small swamp grass); Western Division: Palmer River, 2 miles below junction with Black River, alt. 100 m., *Brass 7364* (A, US) (matted on sand drifts in river). NORTHEAST NEW GUINEA: Morobe District: *Ledermann 10444* (US); Boana, alt. about 900 m., *Clemens* (sine coll. no.), October 20, 1940 (US). NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, alt. 50 m., *Brass 14055* (A, US) (massed on logs floating in backwater lagoons); Waren, 60 miles south of Manokwari, alt. 3 m., *Kanehira and Hatusima 14221* (A) (on edge of rain-forest).

Endemic.

10. **Isachne miliacea** Roth ex Roem. and Schult., Syst. Veg. 2: 476. 1817; Ridley, Trans. Linn. Soc. II. Bot. 9: 247. 1916; Blatter and McCann, Imp. Council Agric. Res. Sci. Monogr. 5: *pl. 123*. 1935. Type from eastern India.

Culms weak, decumbent and creeping, the ascending flowering branches 6–20 (rarely to 30) cm. tall; nodes usually bearded; sheaths shorter than the internodes, glabrous except for the ciliate margin, the cilia continuous with the stiff hairs forming the ligule; blades narrowly oblong, 1–3 cm. long, 3–6 mm. wide, acute, subcordate at base, hispidulous or glabrous, the margins scaberulous; panicle open, 2–5 cm. long, included at base, the branches glandular, ascending, up to 1.5 cm. long; spikelets 1.2–1.5 mm. long; glumes subequal, smooth or scaberulous toward the summit; lower floret staminate, equaling or slightly longer than the glumes, the lemma commonly grooved down the center at maturity; upper floret perfect, ovoid, puberulent, separated from the lower floret by a flattened rachilla.

Indo-Malayan region to New Guinea.

No New Guinea specimens of this species were seen. The description was drawn up from Philippine material. It is included here since it has been reported from Netherlands New Guinea, and its occurrence in New Guinea seems probable.

11. **Isachne globosa** (Thunb.) Kuntze, Rev. Gen. Pl. 2: 778. 1891; Chase, Jour. Arnold Arb. 20: 312. 1939.

Milium globosum Thunb., Fl. Jap. 49. 1784. Type from Japan.

Isachne australis R. Br., Prodr. Fl. Nov. Holl. 1: 196. 1810; F. Muell., Pap. Pl. 2: 19. 1885; Blatter and McCann, Imp. Council Agric. Res. Sci. Monogr. 5: *pl. 122*. 1935. Type from Australia.

Isachne rhabdina (Steud.) Ohwi, Tokyo Sci. Mus. Bull. 18: 1. 1947.

Perennial; culms slender, spreading, often decumbent below and branching, rarely suberect from a tufted base, the flowering branches 15–70 cm. tall; sheaths mostly shorter than the internodes, smooth, ciliate on the margins, the hairs on the upper part longer and continuous with the ciliate ligule, this 2–3 mm. long; blades linear-lanceolate, 2–8 (rarely up to 13) cm. long, 3–8 mm. wide, rather firm in texture, scaberulous; panicle 2–10 cm. long, 2–6 mm. wide, the smooth or scabrous branches ascending and with more or less distinct glandular bands; spikelets 2–2.5 (rarely 3) mm. long; glumes equaling the spikelet or slightly shorter, glabrous or hispidulous toward the obtuse apex; lower floret staminate, slightly larger and of a thinner texture than the glabrous or pubescent perfect floret.

BRITISH NEW GUINEA: Central Division: Vanapa Valley, Urunu, alt. 1900 m., *Brass 4807* (GH, US) (very plentiful in grassland swamps); Western Division: Lake Daviumbu, Middle Fly River, *Brass 7602* (A, US) (plentiful on shores of lake). NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass 10743* (A, US) (abundant on a native clearing in the forest); Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11542* (A, US) (plentiful on sandy beaches of river and on old garden lands); Balim River, alt. 1600 m., *Brass 11823* (A, US) (plentiful on deforested slopes).

Japan to India, Malaysia, New Guinea and Australia.

Brass 7602 is a more robust plant than the others cited, the spikelets are slightly larger and with glumes shorter than the spikelets. Comparison with specimens from other parts of the range, however, show that these differences fall well within the range of variation of the species.

Brass 4807 was cited as *Isachne pangerangensis* Zoll. and Mor. by Hitchcock (35, p. 123).

20. Spinifex L.

Spinifex L., Mant. 2: 163, 300. 1771.

Spikelets lanceolate, unisexual, the pistillate solitary at the base of a long stiff or somewhat flexuous rachis, these stellately arranged in dense spatheate umbels, the heads breaking off at maturity and carried about by the wind or floating on the sea; staminate spikelets borne on rigid spikes, these in spatheate umbels like the pistillate; glumes membranous, the first about half the length of the staminate spikelet, in the pistillate equal to the spikelet; fertile lemma chartaceous-indurate, acuminate, the margins not inrolled. Coarse dioecious perennials with rigid involute or subulate blades and stiff stellate inflorescences.

TYPE SPECIES: *Spinifex squarrosus* L. = *S. littoreus* (Burm. f.) Merr. (*Stipa littorea* Burm. f.).

1. **Spinifex littoreus** (Burm. f.) Merr., Philip. Jour. Sci. Bot. 7: 229. 1912.
Stipa littorea Burm. f., Fl. Ind. 29. 1768. Type from India.
Stipa spinifex L., Mant. 1: 34. 1767. Type from India.
Spinifex squarrosus L., Mant. 2: 300. 1771. Type from India.

Perennial; culms hard, 30–100 cm. or more tall, the internodes more or less pruinose; sheaths broad, overlapping, glabrous or the margins ciliate; ligule a dense ring of hairs 2–4 mm. long; blades 5–20 cm. long, involute-subulate, usually curved, glabrous or the margins scabrous, the tips sharp-pointed; staminate spikelets 2-flowered, 10–12 mm. long, usually several on each spike, the rachis 4–9 cm. long and terminating in a stiff point beyond the spikelets; glumes unequal, the first 5–6 mm. long, the second slightly shorter than the spikelet; florets subequal, the lower membranous, the palea with prominently winged ciliate keels, the upper slightly indurated, the palea not keeled; pistillate spikelets 10–12 mm. long, borne at the base of the scabrous rachis, this 8–15 cm. or more long; first glume equal to or exceeding the spikelet; second glume and sterile lemma equal, the latter empty; fertile lemma a little shorter than the sterile lemma and enclosed within it.

Sandy coasts from India to South China and Malaysia.

1a. **Spinifex littoreus** (Burm. f.) Merr. var. **longifolius** (R. Br.) Backer, Handb. Fl. Java 2: 188. 1928.
Spinifex longifolius R. Br., Prodr. Fl. Nov. Holl. 1: 198. 1810; Pilger, Nat. Pflanzenfam. ed. 2. 14e: 94. *fig. 58*. 1940. Type from Australia.

Differs from the species in having longer often broader and weaker blades (20–50 cm. long), the apex not rigidly pointed, and the rachis of the pistillate inflorescence more slender.

BRITISH NEW GUINEA: Central Division: Hisiu, *Carr 11445* (US, NY). Australia, New Guinea, and Java.

21. Thuarea Pers.

Thuarea Pers., Syn. Pl. 1: 110. 1805.
Ornithocephalochloa Kurz, Jour. Bot. 18: 332. 1875.

Spikelets of two kinds borne in a terminal one-sided raceme included within a sort of spathe at anthesis, the lower 1 or 2 spikelets perfect or pistillate, the upper 3–6 staminate; rachis broad at the base and more or less enclosing the lowest spikelet, narrowed above; upper spikelets with two similar staminate florets, or the lower floret empty; lower 1 or 2 spikelets with one staminate or empty floret and one perfect or pistillate floret. Slender creeping beach grasses. As the fruit matures, the staminate spikelets on the upper part of the rachis fall off and the rachis begins to bend forward and finally encloses the ripened fruit within the perfect spikelet. As this is occurring, the upright branch bends by unequal growth at two or three nodes and the fruit is buried in the sand. The fructification thus formed is more or less waterproof and the seed inside is protected and may float for a considerable time in salt water without injury.[17]

TYPE SPECIES: *Thuarea sarmentosa* Pers. = *T. involuta* (G. Forst.) R. Br. (*Ischaemum involutum* G. Forst.).

1. **Thuarea involuta** (G. Forst.) R. Br.[18] ex Roem. and Schult., Syst. Veg. 2: 808. 1817; Hack., Denkschr. Akad. Wiss. Math.-Naturw. (Wien) 89: 495. 1913.
Ischaemum involutum G. Forst., Fl. Ins. Austr. Prodr. 73. 1786. Habitat in the Society Islands and here and there in the tropics.
Thuarea sarmentosa Pers., Syn. Pl. 1: 110. 1805; Kunth, Rev. Gram. 2: 247. *pl. 35.* 1830; K. Schum. and Lauterb., Fl. Deutsch. Schutzgeb. Südsee 182. 1901. Type from Madagascar.
Ornithocephalochloa arenicola Kurz, Jour. Bot. 18: 332. *pl. 171, fig. 1–18.* 1875. Type from Nicobar Islands.

Culms creeping, forming mats, the upright flowering branches 5–20 cm. tall; sheaths and blades glabrous to more or less velvety-pubescent; sheaths overlapping, ciliate on the margins; ligule a row of hairs 0.5–1 mm. long; blades lanceolate, 2–5 cm. long, 3–6 mm. wide; inflorescence a terminal raceme, the spikelets borne in one series on the puberulent rachis; spikelets puberulent, the staminate about 4 mm. long; first glume small, hyaline; second glume about as long as the spikelet; florets similar, the upper lemma slightly firmer, both containing a staminate flower, or the lower empty; perfect spikelets slightly larger, the glumes and sterile lemma similar to those of the staminate spikelets, the lemma containing a palea and sometimes a staminate flower; fertile floret perfect or pistillate, the lemma smooth and shining except for a few hairs at the apex, the margins clasping the lemma but not inrolled.

17 For a detailed discussion of this interesting phenomenon, see Nieuwenhuis-Uexküll, Margarete (Ann. Bot. Jard. Buitenzorg 18: 114–123. *pl. 14, 15.* 1902).

18 Robert Brown (Prodr. Fl. Nov. Holl. 1: 197. 1810) mentions *Ischaemum involutum* G. Forst. under *Thuarea,* but the combination is not made there.

BRITISH NEW GUINEA: Central Division: Hisiu, *Carr 11417* (NY) (sandy beach). SOLOMON ISLANDS: San Cristoval: Star Harbor, *Brass 3070* (GH).

Islands of the Indian Ocean to Malaysia, New Guinea, Northern Australia, and Islands of the Pacific.

22. Melinis Beauv.

Melinis Beauv., Ess. Agrost. 54. *pl. 11, fig. 4.* 1812.

Tristegis Nees, Hor. Phys. Berol. 47. *pl. 7.* 1820.

Spikelets small, ovate to elliptic, somewhat laterally compressed; first glume minute, nerveless; second glume equaling the sterile lemma, prominently nerved, 2-lobed at apex and bearing a short mucro from between the lobes; sterile lemma similar to the second glume, but bearing a long straight and slender awn; fertile lemma and palea weakly cartilaginous, shorter than the sterile lemma. Annuals or perennials with small spikelets borne in panicles.

TYPE SPECIES: *Melinis minutiflora* Beauv.

1. **Melinis minutiflora** Beauv., Ess. Agrost. 54, *pl. 11, fig. 4.* 1812. Type from Brazil.

   Tristegis glutinosa Nees, Hor. Phys. Berol. 29, 47, 54, *pl. 7.* 1820. Type from Brazil.

   Panicum Melinis Trin., Mém. Acad. St. Petersb. VI. Sci. Nat. 1: 291. 1834. Based on *Melinis minutiflora* Beauv.

Glandular perennial; culms 1 meter or more long, erect or geniculately ascending, often rooting from the lower nodes, usually much branched, glabrous or somewhat pubescent; nodes bearded; sheaths papillose-pilose; ligule a ring of whitish hairs about 1 mm. long; blades flat, pubescent, 5–15 cm. long, 5–12 mm. wide; panicle narrow, more or less contracted, densely flowered, 15–25 cm. long, the slender branches and pedicels scaberulous; spikelets 1.8–2 mm. long, the awn of the sterile lemma 10–15 mm. long.

NORTHEAST NEW GUINEA: Morobe District: Boana, alt. 700–1400 m., *Clemens 11361* (US).

EXPLANATION OF PLATES

All figures are drawn from types.

Plate I

Brachiaria fusiformis Reeder (*Brass 3639*): a. habit, × ½; b & c. two views of spikelet; d. fertile floret (b-d, × 10).

Plate II

Digitaria abortiva Reeder (*Carr 11108*): a. habit, × ½; b. part of rachis; c & d. two views of spikelet (b-d, × 10).

Plate III

Setaria montana Reeder (*Brass 11488*): a. habit, × ½; b & c. two views of spikelet, × 10.

Plate IV

Isachne obtecta Reeder (*Brass 7242*): a. habit, × ½; b. complete spikelet; c & d. two views of spikelet with glumes removed (b-d, × 10).

(*To be concluded*)

GRAMINEAE-PANICOIDEAE OF NEW GUINEA

GRAMINEAE-PANICOIDEAE OF NEW GUINEA

A
B
C
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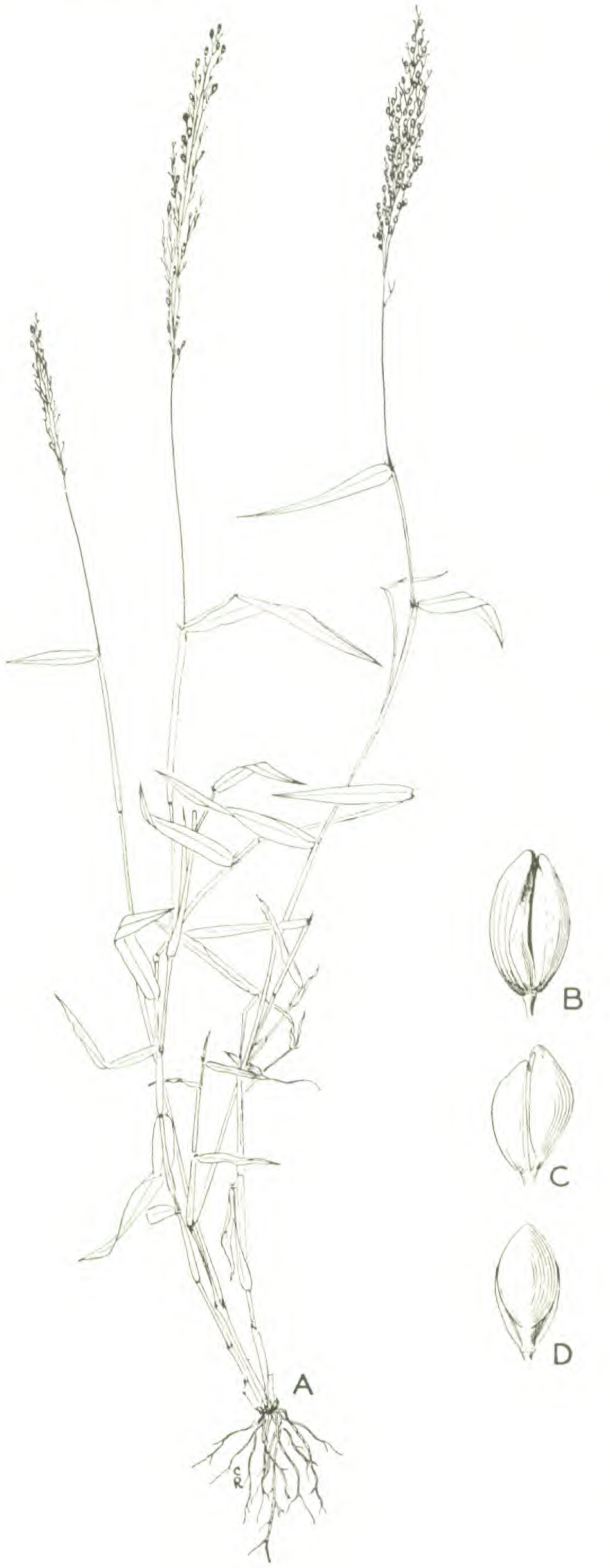

GRAMINEAE-PANICOIDEAE OF NEW GUINEA

JOURNAL

OF THE

ARNOLD ARBORETUM

VOL. XXIX OCTOBER 1948 NUMBER 4

THE GRAMINEAE-PANICOIDEAE OF NEW GUINEA

JOHN R. REEDER

Concluded from page 319

Tribe II. ANDROPOGONEAE

Spikelets 2-flowered, the lower floret often reduced, in pairs (rarely in threes or solitary), one of the pair sessile, the other pediceled, both spikelets similar or more often dissimilar, the sessile spikelet then usually pistillate or perfect and the pediceled staminate or neuter, rarely wanting and only the pedicel remaining (in *Sclerandrium* the sessile spikelets staminate and the pediceled perfect); spikelets falling entire at maturity; rachis either continuous, the spikelets falling free, or articulate, the sessile spikelet falling with the rachis-joint and pedicel attached; glumes more or less indurate, firmer than the lemmas, the first always longer than the florets;. lemmas membranous or hyaline, the upper (fertile) usually with a geniculate awn from the tip or from between the lobes of a bifid apex; stigmas 2, stamens 3 (rarely 1 or 2). Annuals or perennials with often tall culms and solitary, digitate or panicled spikelike racemes.

KEY TO THE GENERA

1. Spikelets strongly laterally compressed, solitary at each node.....23. *Dimeria.*
1. Spikelets dorsally compressed or rounded, usually 2–3 at each node (sometimes solitary by the suppression of the pediceled spikelet).
   2. Spikelets all alike and fertile, or if unlike the sessile spikelet staminate, the pediceled perfect (sometimes the pediceled spikelets reduced in *Microstegium*).
      3. Sessile spikelets perfect, pediceled spikelets usually also perfect.
         4. Rachis continuous, not disarticulating, the spikelets falling free (see also *Eulalia irritans*).
            5. Spikelets awnless, borne in narrow spikelike panicles.....24. *Imperata.*
            5. Spikelets awned (in ours), borne in broad flabellate panicles.....25. *Miscanthus.*
         4. Rachis disarticulating, the sessile spikelets falling with the rachis joint and pedicel attached.
            6. Racemes numerous, paniculate on an elongate common axis.
               7. Fertile lemma awnless, usually much reduced.....26. *Saccharum.*
               7. Fertile lemma well developed, mucronate or with a well developed awn.....27. *Erianthus.*

6. Racemes 1 — several, subdigitate or approximate on a shortened common axis.
8. Racemes several, subdigitate or approximate; spikelets 1-awned, or if 2-awned the awns dissimilar.
9. Culms erect or ascending; blades linear; first glume flat or with only a slight groove.....28. *Eulalia.*
9. Culms straggling; blades lanceolate with short petioles; first glume with usually a distinct dorsal groove.....29. *Microstegium.*
8. Racemes solitary; spikelets 2-awned, the awns similar.....30. *Pogonatherum.*
3. Sessile spikelets staminate; pediceled spikelets perfect, long awned.....31. *Sclerandrium.*
2. Spikelets not all fertile, usually differing also in size, shape and awns; sessile spikelet fertile, the pediceled staminate or neuter, often much reduced, sometimes completely wanting, only the pedicel remaining (if spikelets similar then the rachis joints and pedicels thickened).
10. Rachis joints and pedicels thickened, either trigonous, rounded, or flattened (sometimes the pedicel more or less reduced).
11. Racemes reduced to a single joint of three spikelets, each raceme partly enclosed in a swollen bract or spathe, these solitary at the ends of the panicle branches.....33. *Apluda.*
11. Racemes not as above, several- to many-jointed.
12. Rachis joints and pedicels trigonous, not at all flattened or hollowed out on the side next to the sessile spikelet; fertile lemma usually awned.....32. *Ischaemum.*
12. Rachis joints and pedicels flattened, rounded or hollowed out on the side next to the sessile spikelet; fertile lemma awnless.
13. First glume of sessile spikelet subhemispheric, foveolate, the margins clasping the edges of the fused rachis joint and pedicel.....34. *Hackelochloa.*
13. First glume of sessile spikelet dorsally flattened or slightly convex.
14. Sessile spikelets not deeply sunken in the cavities of the rachis joints; first glume pectinate or with stiff setae on the keels.
15. First glume with a line of balsam glands just inside the keels, the apex bearing two long flattened aristate teeth about as long as the body; pediceled spikelets present.....37. *Elyonurus.*
15. First glume without such glands, obtuse; pediceled spikelets wanting, the pedicels glume-like or stipe-like.....36. *Eremochloa.*
14. Sessile spikelets more or less deeply sunken in the cavities of the rachis joints; first glume smooth on the keel, not pectinate.
16. Pediceled spikelets present.
17. Pediceled and sessile spikelets similar; rachis tenacious, disarticulating very tardily.....35. *Hemarthria.*
17. Pediceled and sessile spikelets dissimilar; rachis fragile, disarticulating readily.....38. *Rottboellia.*
16. Pediceled spikelets wanting, the pedicels firmly fused to the rachis joints.
18. Spikelets all borne on one side of the rachis; first glumes asymmetrical, the apices pointing in alternate directions.....39. *Thaumastochloa.*
18. Spikelets borne alternately on either side of the rachis; first glume symmetrical.....40. *Ophiuros.*
10. Rachis joints and pedicels slender (sometimes somewhat thickened upward); fertile spikelet usually awned.
19. Fertile spikelets disarticulating horizontally, the callus short, blunt.

20. Blades cordate; awn of fertile lemma arising from the base.....43. *Arthraxon.*
20. Blades not cordate; awn of fertile lemma, if present, arising from the tip or from between the teeth of a bifid apex.
21. Racemes in pairs, one sessile, the other peduncled, included in an inflated spathe, these aggregated into a large compound inflorescence; lowest pair of spikelets in one or both racemes homogamous.....45. *Cymbopogon.*
21. Inflorescence not as above.
22. Glumes firmly indurate, smooth and shining.....41. *Sorghum.*
22. Glumes membranous-coriaceous, often more or less prominently nerved.....44. *Andropogon.*
19. Fertile spikelets disarticulating obliquely, the callus pungent-pointed.
23. Racemes without pairs of homogamous spikelets at base.....42. *Chrysopogon.*
23. Racemes with 1 or more pairs of homogamous spikelets at base, these staminate or neuter.
24. Racemes capitate, solitary, long-exserted.....48. *Germainia.*
24. Racemes not as above.
25. Fertile spikelets dorsally flat or grooved; first glume chartaceous..46. *Hyparrhenia.*
25. Fertile spikelets terete; first glume coriaceous.
26. Homogamous pairs of spikelets 2, approximate and forming a sort of involucre at base of the 1–3-jointed raceme; inflorescence a large spatheate panicle.....47. *Themeda.*
26. Homogamous pairs of spikelets 1 to many at base of the several to many-jointed raceme; inflorescence a solitary spikelike raceme terminating the culms and branches; sterile spikelets obliquely lanceolate, imbricate and obscuring the fertile spikelets.....49. *Heteropogon.*

23. Dimeria R. Br.

Dimeria R. Br., Prodr. Fl. Nov. Holl. 1: 204. 1810.
Haplachne Presl, Rel. Haenk. 1: 234. *pl. 38.* 1830.
Woodrowia Stapf, Hook. Ic. 25: *pl. 2447.* 1896.

Spikelets strongly laterally compressed, short-pediceled, solitary in two rows on one side of a trigonous or flattened continuous rachis; glumes keeled, often winged, only slightly indurate, the margins usually hyaline; first glume usually narrower and slightly shorter than the second; lemmas hyaline, the sterile shorter, awnless, the fertile rarely awnless, usually awned from the bifid apex, the awn geniculate, the basal segment brown and twisted; stamens 2. Annuals or perennials with usually slender culms and digitate or approximate, sometimes solitary, racemes.

TYPE SPECIES: *Dimeria acinaciformis* R. Br.

KEY TO THE SPECIES

1. Spikelets 3.5–5 mm. long.
2. Racemes solitary.....1. *D. monostachya.*
2. Racemes 2 to 5.
3. Both glumes prominently winged on the keel; rachis 1 mm. wide, densely ciliate on the margins.....2. *D. dipteros.*
3. First glume not winged; rachis about 0.8 mm. wide, scabrous or only sparsely ciliate on the margins.....3. *D. ciliata.*

1. Spikelets 2–2.5 mm. long.
   4. Second glume not winged on the keel; fertile floret awned, the awn geniculate. . . . . 4. *D. ornithopoda.*
   4. Second glume winged on the keel; fertile floret awnless or with a reduced straight awn. . . . . 5. *D. glabriuscula.*

1. **Dimeria monostachya** sp. nov. PLATE V, *Figs. a, b.*

Annua 25–45 cm. alta; culmis filiformibus, erectis, glabris; nodis breviter barbatis, circiter 7; vaginis carinatis, pilosis, pilis circiter 1 mm. longis; ligula membranacea, circiter 0.5 mm. longa; laminis planis vel conduplicatis, erectis, 2–3 mm. latis, inferioribus 4–8 cm. longis, ad apicem culmis brevioribus, marginibus plus minusve revolutis, utrinque pilosis, pilis quam eis vaginae paullo longioribus; racemo solitario, 5–7 cm. longo, floribus confertis; rhachi circiter 0.8 mm. lata, complanata, dorso leviter rotundato, marginibus dense ciliatis; pedicellis complanatis, circiter 0.2 mm. longis; spiculis imbricatis, 3.5–4 mm. longis; glumis dense albopilosis, carinis longe ciliatis; gluma prima acuta, quam gluma secunda paullo breviore, carina haud alata; gluma secunda acuminata, quam gluma prima duplo latiore, carina tota longitudine late alata, margine ciliato, ceterum glabra; lemmate sterili quam fertili paullo breviore; lemmate fertili quam spicula circiter quarta parte breviore, arista circiter 8 mm. longa, columna 1–1.5 mm. longa; antheris circiter 0.8 mm. longis.

BRITISH NEW GUINEA: Western Division: Lake Daviumbu, Middle Fly River, *Brass 7806* (A, TYPE, US), September, 1936 (gregarious on wetter savannahs).

Closely related to *Dimeria sinensis* Rendle, but differing in having larger spikelets in which the second glume is acuminate rather than obtuse, and in the shorter awn in which the column is 1–1.5 mm. long rather than 3–4 mm. as in *D. sinensis.* The habit suggests *D. pusilla* Thwaites, but that species is smaller and has larger spikelets in which the glumes are aristate.

The above specimen was reported as *Dimeria falcata* Hack. by Chase (17, p. 313).

2. **Dimeria dipteros** sp. nov. PLATE VI.

Annua 30–80 cm. alta; culmis glabris, simplicibus, erectis vel adscendentibus; nodis barbatis, pilis adscendentibus circiter 2 mm. longis; vaginis carinatis, dense pilosis, quam internodiis longioribus; ligula membranacea, ciliolata, circiter 0.6 mm. longa; laminis erectis, planis, 5–12 cm. longis, 3–5 mm. latis (summa valde redacta) dense pilosis; racemis binatis vel ternatis, 5–8 cm. longis; rhachi circiter 1 mm. lata, anguste alata, alis dense rigido-ciliatis, pilis 0.5–1 mm. longis, ceterum glabra; pedicellis complanatis, circiter 0.5 mm. longis, marginibus apicem versus rigido-ciliatis, pilis quam pedicellis paullo longioribus; spiculis plus minusve pubescentibus, anguste obovatis, callo breve barbato; glumis subaequalibus, acutis, carinis late alatis, marginibus ciliatis, pilis apicem versus brevioribus; gluma prima 4–4.5 mm. longa, carina quam corpo glumae plerumque paullo latiore; gluma secunda 4.5–5 mm. longa, 1.5 mm. lata, carina circiter 0.5 mm. lata, apicem versus paullo latiore; lemmate sterili scariosa, ciliata, 2.5–3 mm. longa; lemmate fertili 3.5–4 mm. longa, aristata; arista 8–10 mm. longa, e apicem lemmatis bifida, columna 1.5–2 mm. longa; antheris 1.5 mm. longis.

BRITISH NEW GUINEA: Central Division: Urunu, Vanapa Valley, alt. 1900 m., *Brass 4802* (GH, US) (a few plants among sedges in small swampy hollows on

grassland). NETHERLANDS NEW GUINEA: Balim River, alt. 1800 m., *Brass 11738* (A, US, TYPE), Dec. 1938 (common on sandy, long deforested slopes).

Related to *Dimeria bialata* C. E. C. Fisch. but that species is much smaller and has much shorter racemes, slightly smaller more glabrous spikelets, anthers 1 mm. long, and an awn with the column about 3 mm. long.

Comparison may also be made with *Dimeria chloridiformis* (Gaudich.) K. Schum. & Lauterb., but that species has somewhat longer leaves, culms which are pubescent below the inflorescence, racemes in 4's or 5's, and the common axis pubescent rather than glabrous. The greatest difference, however, is seen in the spikelets, in which the first glume is apiculate and wingless, the second acuminate and with only a very small wing just below the tip. The anthers are 1.8 mm. long.

Brass 4802 was reported as *Dimeria chloridiformis* by Hitchcock (35, p. 124).

3. **Dimeria ciliata** Merr., Philip. Jour. Sci. Bot. 9: 262. 1914. Type from the Philippines.

Perennial; culms slender, tufted, more or less pubescent, 50–85 cm. tall; nodes bearded, the hairs stiffly ascending, 1–1.5 mm. long; sheaths slightly shorter than the internodes, more or less pilose, keeled, at least above; ligule about 0.8 mm. long, membranous, often ciliate; blades more or less densely pilose, 8–25 cm. long, 3–5 mm. wide; inflorescence long-exserted, of 3–6 racemes, the common axis about 1 mm. long; racemes 7–13 cm. long, the rachis trigonous, about 0.8 mm. wide, glabrous or slightly ciliate on the margin, sometimes slightly pubescent on the back; pedicels 0.8–1 mm. long, rather stout, ciliate on the outer margins; spikelets 4–4.5 mm. long, the glumes prominently ciliate with long white hairs on the keels; the first glume slightly shorter and narrower than the second, not winged; second glume with a prominent wing on the keel toward the apex, the lower half wingless; sterile lemma about 3 mm. long, ciliate; fertile lemma about 3.5 mm. long, the awn about 10 mm. long; anthers about 1 mm. long.

BRITISH NEW GUINEA: Western Division: Dagwa, Oriomo River, alt. about 40 m., *Brass 5911* (A, US, NY) (scattered in small, spreading tufts on damp ridge slopes).

Philippines, New Guinea.

Related to *Dimeria chloridiformis* (Gaudich.) K. Schum. & Lauterb., from the Marianas, but differing in the smaller spikelets, less pubescent foliage, and narrower rachises, which are not densely ciliate.

Brass 5911 was reported as *Eulalia argentea* Brongn. var. *queenslandica* (Domin) Hitchc. by Hitchcock (35, p. 126). The combination which he makes there is a valid one but does not apply to the New Guinea plants.

3a. **Dimeria ciliata** Merr. var. **heteromorpha** var. nov.

A typo differt culmis vaginisque glabris, laminis glabris vel marginibus plus minusve pilosis basi tuberculatis, ala glumae secundae interdum ad basin imam extendit.

BRITISH NEW GUINEA: Western Division: Lake Daviumbu, Middle Fly River, *Brass 7807* (A, TYPE, US), Sept. 1936 (gregarious in small patches on wet savannahs), *Brass 7932* (A, US) (plentiful on moist savannah slopes).

Differs from the species in having glabrous culms and sheaths, the blades glabrous or with the margins more or less tuberculate-pilose, and the wing of the second legume sometimes extending all the way to the base. The varietal epithet refers to the variable nature of the spikelets. Within the same inflorescence, in some spikelets the second glumes are winged only at the apex as in typical *Dimeria ciliata*, in others the wings extend entirely to the base, and there are numerous intergradations.

4. **Dimeria ornithopoda** Trin., Fund. Agrost. 167. *fig. 14.* 1820; C. T. White, Proc. Roy. Soc. Queensl. 34: 14. 1923. Type from India.

Annual; culms glabrous, slender, tufted, 15–30 cm. tall (rarely taller), the nodes bearded; sheaths mostly shorter than the internodes, keeled, glabrous to papillose-pilose; ligule about 0.5 mm. long; blades erect, as much as 6 cm. long, 2–3 mm. wide, glabrous or papillose-pilose; racemes binate or ternate, 2–5 cm. long, the rachis undulate, trigonous, about 0.3 mm. wide or less, the margins scabrous; pedicels very short; spikelets 2–2.5 mm. long, the callus short-bearded; glumes subequal, acute, scabrous or somewhat pubescent, the keels not winged; fertile lemma slightly shorter than the first glume and bearing a geniculate awn, the column of which is about as long as the spikelet; anthers about 0.5 mm. long.

Widely distributed in the tropics and subtropics of the Old World.

No specimens of this species were seen from New Guinea — the description was drawn up from Philippine and Australian specimens. Included here since it was reported by White, and it seems probable that it occurs in New Guinea.

5. **Dimeria glabriuscula** F. M. Bailey, Syn. Queensl. Fl. Suppl. 3: 83. 1890. Type from Australia.

Dimeria glabra Ridley, Fl. Malay Penin. 5: 192. 1925; Hitchc., Brittonia 2: 125. 1936. Type from Singapore.

Annual; culms glabrous, erect, tufted, very slender, 20–50 cm. tall, the nodes minutely bearded; sheaths keeled, glabrous or slightly ciliate on the margins; ligule about 0.5 mm. long; blades 2–6 cm. long, 2–3 mm. wide, glabrous or slightly pubescent; racemes binate or ternate, 3–6 cm. long, the trigonous rachis about 0.4 mm. wide, undulate, the margins scabrous; pedicels very short; spikelets 2–2.5 mm. long, the callus not bearded; glumes subequal, acute, the first narrow, scabrous, the second about twice as wide as the first, scabrous or rarely slightly puberulent, the keel with a narrow wing extending quite or nearly to the base; fertile lemma slightly shorter than the first glume, awnless or with a short straight awn (rarely a few of the spikelets with a geniculate awn); anthers about 0.5 mm. long.

BRITISH NEW GUINEA: Western Division: Dagwa, Oriomo River, alt. 40 m., *Brass 5984* (GH, US) (in small patches or colonies on damp grass slopes); Lake Daviumbu, Middle Fly River, *Brass 7850* (A, US) (rare grass, gregarious on wet savannahs).

Singapore, Netherlands Indies, the Philippines, New Guinea to Australia.

Closely related to *Dimeria ornithopoda* but differing in being more nearly glabrous and in having a more erect habit. Further differences are seen in the spikelets, which are not bearded on the callus, have the second glume winged on the keel, and the fertile lemma awnless or with a reduced straight awn.

24. Imperata Cyrillo

Imperata Cyrillo, Pl. Rar. Neap. 2: 26. *pl. 11*. 1792.

Spikelets more or less dorsally compressed, all alike and perfect, usually in pairs (rarely solitary), unequally pediceled, along a slender continuous rachis, surrounded by long silky hairs from the base and lower part of the glumes; glumes about equal, membranous; lemmas hyaline, awnless, shorter than the glumes; styles 2; stamens 1 or 2. Perennials with stout creeping rhizomes and more or less spikelike, conspicuously silky panicles.

TYPE SPECIES: *Imperata arundinacea* Cyrillo = *I. cylindrica* (L.) Beauv. (*Lagurus cylindricus* L.).

KEY TO THE SPECIES

1. Stamens 2; panicle dense, spikelike.....1. *I. cylindrica.*
1. Stamen 1; panicle somewhat open (rather dense in high altitude form).....2. *I. exaltata.*

1. **Imperata cylindrica** (L.) Beauv., Ess. Agrost. 165, 177, *pl. 5, fig. 1*. 1812; Hitchc., Brittonia 2: 125. 1936; Pilger, Nat. Pflanzenfam. ed. 2. 14e: 111. *fig. 64*. 1940.

Lagurus cylindricus L., Syst. Nat. ed. 10. 2: 878. 1759. No locality given.
Imperata arundinacea Cyrillo, Pl. Rar. Neap. 2: 27. *pl. 11*. 1792; F. Muell., Vict. Nat. 1: 168. 1844; Hack. in DC., Monogr. Phan. 6: 92. 1889. Type from Italy.

1a. **Imperata cylindrica** (L.) Beauv. var. **major** (Nees) C. E. Hubb. in C. E. Hubb. & Vaughan, Grass. Maurit. and Rodriguez 96. 1940.

Saccharum Koenigii Retz., Obs. Bot. 5: 16. 1789. Type from Japan.
Imperata Koenigii (Retz.) Beauv., Ess. Agrost. 165. 1812.
Saccharum confertum Presl, Rel. Haenk. 1: 346. 1830. Type from the Philippines.
Imperata Koenigii (Retz.) Beauv. var. *major* Nees, Fl. Afr. Austr. 90. 1841. Type from Africa.
Imperata arundinacea Cyrillo var. *Koenigii* (Retz.) Benth., Fl. Hongk. 419. 1861; Hack., Bot. Jahrb. 6: 238. 1855, in DC., Monogr. Phan. 6: 94. 1889.
Imperata cylindrica (L.) Beauv. subvar. *Koenigii* (Retz.) Durand & Schinz, Consp. Fl. Afr. 5: 694. 1894.
Imperata cylindrica (L.) Beauv. var. *Koenigii* (Retz.) Pilger in Perk., Fragm. Fl. Philip. 137. 1904; Hack., Denkschr. Akad. Wiss. Math.-Naturw. (Wien) 89: 492. 1913.
Imperata conferta (Presl) Ohwi, Bot. Mag. (Tokyo) 55: 549. 1941.

Culms erect, simple, slender to moderately stout, 40–120 cm. tall, mostly 1- to 3-noded, the nodes bearded; sheaths overlapping, keeled, glabrous or slightly pubescent; ligule truncate, 0.5–1 mm. long; blades linear-lanceolate, broadest at the middle and tapering to either end, flat, very variable in length, 10–50 cm. or more long, 5–15 mm. wide, glabrous or hairy at the base, scabrous on the margins; panicle usually densely cylindric, sometimes slightly branching at the base, 5–22 cm. long; spikelets 3–4 mm. long, the hairs about 10 mm. long; glumes subequal, membranous, 3–7-nerved; anthers 2, borne on long slender filaments.

BRITISH NEW GUINEA: Western Division: Gaima, Lower Fly River, *Brass 8296* (A, US) (covering old clearings in both savannah and rain-forest). NORTHEAST NEW GUINEA: Morobe District: Near Kajabit Mission, alt. about 200 m., *Clemens 10668b* (US); in the Ramu Valley near the headwaters of the Markham River, *Rogers 3001* (A); four miles south of Langemak Bay, *Sawyer 81* (A); near Yabim, *H. Zahn* in 1903 (US).

East Africa, Indo-Malayan region, New Guinea to Australia. Also Japan.

Imperata cylindrica is an extremely variable and wide-ranging species, and hence it has a large number of synonyms. C. E. Hubbard (Imp. Agric. Bur. Joint Publ. 7:5–13. *1 map.* 1944) recognizes five varieties, one of which occurs in South America and the rest in the Old World. Variety *major,* to which our plants appear to belong, has a greater range than the others and probably a greater variability. According to Hubbard, each of the varieties has a rather definite geographic distribution.

2. **Imperata exaltata** Brongn. in Duperry, Bot. Voy. Coquille 2(2): 101. 1831; Hack. in DC., Monogr. Phan. 6: 98. 1889; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 165. 1901; Hitchc., Brittonia 2: 125. 1936. Type from Waigiou Island.

Saccharum macilentum Chauvin ex Steud., Syn. Pl. Glum. 1: 406. 1854; F. Muell., Pap. Pl. 1: 47. 1876. Type from Waigiou Island.

Culms 60–150 cm. tall (rarely only 25 cm. in subsp. *Merrillii*), slender in proportion to their height, 3–4-noded, the nodes not bearded; sheaths overlapping, more or less keeled; ligule truncate, shortly ciliate, 0.5–1.5 mm. long; blades lanceolate-linear or rarely linear, flat or sometimes involute, 25–80 cm. long, 6–20 mm. wide, the base attenuate and distinctly canaliculate at the junction of the sheaths, glabrous or pilose only at the base, the margins scabrous; panicle as much as 40 cm. long, 3–7 cm. wide, with numerous short rather lax branches especially toward the base; spikelets 2.5–3 mm. long, the hairs 2 to 3 times as long; glumes subequal, 3-nerved; stamen 1, 2–2.5 mm. long.

BRITISH NEW GUINEA: Islands near the southeast end, *Armit 55* (US); Central Division: Urunu, Vanapa Valley, *Brass 4813* (A, US) (common on paths through old garden lands); Kanosia, *Carr 11244* (NY) (on open savannah land); Western Division: Junction of the Black and Palmer Rivers, *Brass 6945* (A, US) (forming dense pure stands on a gravel island in the Palmer River); Northern Division: About 9 miles northwest of Oro Bay, *Reeder 813* (A, US) (bank of creek in partial shade). NORTHEAST NEW GUINEA: Morobe District: Huon Gulf, *Herre 231* (NY). NETHERLANDS NEW GUINEA: Nassau region, Explorat Biv., alt. about 700 m., *Docters van Leeuwen 10500* (GH). NEW BRITAIN: *Parkinson 65* (US).

Southeastern Asia to New Guinea.

2a. **Imperata exaltata** Brongn. subsp. **Merrillii** Hack., Philip. Jour. Sci. 1: Suppl. 264. 1906. Type from the Philippines.

Differs from the typical form in having narrower blades and a shorter, denser panicle. The spikelets seem to be identical and have only one stamen as in the species.

BRITISH NEW GUINEA: Central Division: Wharton Range, Murray Pass, alt. 2840 m., *Brass 4721* (A, US) (common on hillsides and in open country). NETHERLANDS NEW GUINEA: Northern slopes of Mount Wilhelmina, Wemena River, alt. 3200 m., *Brass & Meyer-Drees 10235* (A, US) (covering beaches of gravel and sand); 9 km. northeast of Lake Habbema, alt. 2600 m., *Brass 10902* (A, US) (on old landslip in forest); Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11491* (A, US) (dominant grass on old garden lands).

Philippines and New Guinea.

The cited specimens look superficially like *Imperata cylindrica* and were cited under this name by Chase (24, p. 88). They differ in having slightly smaller spikelets with only one stamen. This is apparently a

high altitude form of *I. exaltata* and perhaps not worthy of subspecific status.

25. Miscanthus Anderss.

Miscanthus Anderss., Oefv. Svensk. Vet. Akad. Foerhandl. Stockh. 1855: 165. 1856.
Eulalia Trin., Mém. Acad. St. Pétersb. VI. 2: 332. 1832 (non Kunth, 1829).
Xiphagrostis Coville, Contr. U. S. Nat. Herb. 9: 399. *pl. 69*. 1905.

Spikelets all alike and perfect, in pairs, unequally pediceled on a continuous rachis, the callus villous; glumes subequal, chartaceo-membranous; lemma hyaline, the fertile bifid and awned or rarely awnless, the awn twisted, straight or slightly geniculate. Tall perennials with long flat or convolute blades and large open terminal panicles of several to many racemes.

TYPE SPECIES: *Miscanthus japonicus* Anderss. = *M. floridulus* (Labill.) Warb. (*Saccharum floridulum* Labill.).

1. **Miscanthus floridulus** (Labill.) Warb. in K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 166. 1901; C. T. White, Proc. Roy. Soc. Queensl. 34: 15. 1923.
Saccharum floridulum Labill., Sert. Austro. Caled. 13. *pl. 18*. 1824. Type presumably from New Caledonia.
Miscanthus japonicus Anderss., Oefv. Svensk. Vet. Akad. Foerhandl. Stockh. 1855: 166. 1856; Warb., Bot. Jahrb. 16: 13. 1892; Hitchc., Proc. Linn. Soc. N. S. Wales 54: 145. 1929 (non *Saccharum japonicum* Thunb. 1794). Type from Japan.

Culms in large clumps, erect, robust, 1.5–4 meters tall; sheaths overlapping, glabrous, not keeled; ligule membranous, about 1 mm. long, often ciliate; blades 25–80 cm. long, 10–30 mm. wide, rather firm, the margins serrulate-scabrous; panicle broad, flabellate, 15–40 cm. long, the central axis about two-thirds as long; lower branches 15–20 cm. long, the rachis glabrous or sometimes pilose; spikelets 3–5 mm. long, the soft spreading callus hairs about as long; awn about 3–8 mm. long.

BRITISH NEW GUINEA: Gulf Division: Ihu, Vailala River, *Brass 920* (GH, US) (in large thickets on the river banks); Central Division: Wharton Range, Murray Pass, alt. 2800 m., *Brass 4191* (A, US) (large tussock grass scattered on open slopes), *Brass 4528* (GH, US) (rare; sporadic on open grasslands), *Brass 4723* (US) (rare; in large clumps on open country); Urunu, Vanapa Valley, alt. 1900 m., *Brass 4778* (GH, US) (covers large areas of old garden land on deforested valley slopes. NORTHEAST NEW GUINEA: Morobe District: Sattelberg, Ogeramnang, alt. about 1800 m., *Clemens 4454* (A); Sarawaket, alt. about 2500 m., *Clemens 6145* (A). NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11584* (forming occasional thickets in open second growths); Balim River, alt. 1600 m., *Brass 11809* (A, US) (a few clumps on river bank).

Eastern Asia to Polynesia.

26. Saccharum L.

Saccharum L., Sp. Pl. 54. 1753; Gen. Pl. ed. 5. 28. 1754.

Spikelets all alike and perfect, awnless, in pairs, one sessile, the other pediceled on an articulate fragile rachis, this disarticulating below the spikelets; glumes equal, somewhat indurate, often more firm below, the first usually 2–4-nerved (rarely with a midnerve), the second 1–5-nerved; sterile lemma hyaline, about as long as the glumes; fertile lemma much reduced or wanting. Tall perennials with large silky terminal panicles.

TYPE SPECIES: *Saccharum officinarum* L.

1. **Saccharum spontaneum** L., Mant. 2: 183. 1771; F. Muell., Pap. Pl. 1: 46. 1879; Hack., Bot. Jahrb. 6: 238. 1885, in DC., Monogr. Phan. 6: 113. 1889. Type from India.

Imperata spontanea (L.) Beauv. ex Roem. & Schult., Syst. 2: 289. 1817.

Saccharum robustum Brandes & Jeswiet ex Grassl, Jour. Arnold Arb. 27: 234. 1946. Type from New Guinea.

Culms in dense tufts or clumps, 2–10 meters tall, slender and more or less woody at base to robust and pithy, erect or somewhat decumbent at base; sheaths longer than the internodes, sparsely to densely pubescent, the hairs usually more dense near the margins; ligule membranous, short ciliate, 1.5–4 mm. long; blades long-linear, 1–5 (rarely 7) cm. wide, the margins serrulate-scabrous; panicle 20–90 cm. long, the fragile branches suberect or spreading; rachis long-pilose or only scabrous; spikelets 3–5.5 mm. long, the glumes usually more or less firmly indurate and often reddish on the lower half, the upper margins ciliate; sterile lemma well developed, about as long as the glumes; fertile lemma very much reduced or completely wanting.

BRITISH NEW GUINEA: Central Division: Rona, Laloki River, alt. 450 m., *Brass 3628* (A, US) (on roadsides in savannahs, not common); near Port Moresby, Rauna Falls, *Jeswiet* in 1928 (US); Kanosia, *Carr 11129* (NY) (open savannah land); banks of the Laloki River, about 27 km. from Port Moresby, *Jeswiet* in June, 1928 (US) (type of *S. robustum*); Northern Division: Near Dobodura, on banks of Samboga River, *Reeder 828* (A, US) (on gravelly soil; culms 3–4 meters tall); Western Division: Palmer River, *Brass 6957* (A) (stands 3–4 meters high on gravel banks of the river). NORTHEAST NEW GUINEA: Morobe District: *Clemens 6558* (A); Wareo, alt. 625 m., *Clemens 1410* (A); Ongerman [sic], on the Sepik River, *Herre 284* (NY) (on river banks; plants 10–20 feet high; covers tens of thousands of acres extending along the Sepik River for over 500 m. from the sea and beyond for an unknown distance). NETHERLANDS NEW GUINEA: Near Hollandia, *Brass 8920* (A) (forming small thickets 2–3 meters high along the river); 18 km. northeast of Lake Habbema, Bele River, alt. 2200 m., *Brass 11374* (A, US) (very abundant in tall thickets on abandoned garden land, 2.5–3 meters high); Balim River, alt. 1600 m., *Brass 11778* (A, US) (abundant on alluvial soil of river banks; gregarious in clumps about 2 meters high); 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13264* (A, US) (colonizing sand and gravel beaches in river; thickets up to 8 meters high); Bernhard Camp, Idenburg River, alt. 50 m., *Brass 13791* (A, US) (in dense pure stands 7–8 meters high on recent silt deposits of the river banks).

Widely distributed from the Indo-Malayan region to New Guinea and adjacent islands.

Saccharum robustum Brandes & Jeswiet ex Grassl is here treated as a synonym, since the distinctions given by Grassl as separating it from *S. spontaneum* do not seem to hold. In the discussion following the original description one reads that *S. robustum* is "distinguished readily" by the reduced third glume [fertile lemma], the sparser and shorter hairs on the rachis and callus, the smaller spikelets, and the much larger size of the plants themselves. Examination of available specimens shows that these distinctions have little basis in fact. The fertile lemma is reduced in all the cited specimens, although the degree of reduction varies in different plants and even in different spikelets in the same panicle. Grassl implies that the large, robust plants (*S. robustum*) have small spikelets, while in the smaller plants (*S. spontaneum*) the spikelets are larger. *Carr 11129*

is a small plant with a slender, woody culm, yet the spikelets are only about 3 mm. long. *Brass 6957* has rather robust culms, broad blades, and small spikelets, yet on the label the height of the plant is given as "3–4 m." *Brass 11374* has the broad blades and robust culms of *S. robustum*, yet the spikelets are 5–5.5 mm. long, and the height of the plants is given as only 2.5–3 meters. There seems also to be little correlation between the size of the spikelets and the length of the hairs on the rachis and callus. In view of the difficulty, if not impossibility, of separating coherent groups from the New Guinea material, it seems advisable to consider it as one polymorphic species pending further detailed collecting and field study.

2. **Saccharum officinarum** L., Sp. Pl. 54. 1753; Hack. Bot. Jahrb. **13**: 263. 1890; Pilger, Nat. Pflanzenfam. ed. 2. **14e**: 114–116. *fig. 66*. 1940. Type from India.
Saccharum sinense Roxb., Fl. Ind. **1**: 244. 1820; Ohwi, Bot. Mag. (Tokyo) **56**: 9. 1942. Described from specimens in Botanical Garden introduced from China.

This is the cultivated sugar cane. It is widely distributed and cultivated by natives throughout the Island and is spontaneous in old garden lands. The culms are 2–6 meters tall and 2–4 cm. in diameter. The lower internodes are often very short and stout. No herbarium specimens of this species from New Guinea have been seen. Living plants were observed in native gardens on numerous occasions while the writer was there in 1943–44. Unfortunately no specimens were collected.

3. **Saccharum edule** Hassk., Flora 25: Beibl. 3. 1842. Type from Java.
Saccharum spontaneum L. var. *edulis* (Hassk.) K. Schum. in K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 166. 1901.

In this species the inflorescence fails to develop normally and remains permanently enclosed within the sheaths of the upper leaves. This abortive inflorescence is roasted and eaten as a vegetable by the natives. Since it produces no flowers, the plant can be propagated only by vegetative means. Grassl (Jour. Arnold Arb. **27**: 240–242. 1946) discusses the relationship of this horticultural species with other species of *Saccharum*. He also (op. cit. *pl. 2, fig. 1, 2*) figures the abortive inflorescence. The species is apparently cultivated throughout the island. As seen growing, it resembles *S. officinarum*, but the culms are dry and do not contain sweet juice. Hackel (24, p. 263) doubtfully reports *S. edule* from New Guinea.

No specimens of this species were available to the writer, but living plants were observed in a native garden in British New Guinea in 1943. As in the case of the former species, no specimens were collected.

27. **Erianthus** Michx.

Erianthus Michx., Fl. Bor. Amer. 1: 54. 1803.

Spikelets all alike and perfect, awned or awn-pointed, in pairs along a slender rachis, one sessile, the other pediceled, the rachis disarticulating below the spikelets, the rachis joint and pedicel falling attached to the sessile spikelet; glumes coriaceous, equal, usually clothed with long spread-

ing silky hairs; sterile lemma hyaline, empty; fertile lemma hyaline, the midnerve extending into a prominent awn or the lemma at least awn-pointed. Perennials with dense terminal silky panicles.

TYPE SPECIES: *Erianthus saccharoides* Michx. = *E. giganteus* (Walt.) Muhl. (*Anthoxanthum giganteum* Walt.).

KEY TO THE SPECIES

1. Fertile lemma mucronate or the awn only about 1 mm. long; panicle 25–60 cm. long.....1. *E. arundinaceus.*
1. Fertile lemma with an awn as long as the spikelet or longer; panicles about 15 cm. long.....2. *E. fastigiatus.*

1. **Erianthus arundinaceus** (Retz.) Jesw., Arch. Suikerind Nederland Indië Meded. 33: 399. 1925; Pilger, Nat. Pflanzenfam. ed. 2. 14e: 118. 1940.
Saccharum arundinaceum Retz., Obs. Bot. 4: 14. 1786; Hack. in DC., Monogr. Phan. 6: 117. 1889; Ridley, Trans. Linn. Soc. II. (Bot.) 9: 249. 1916. Type from India.

Culms robust, 2–5 (sometimes to 7) meters tall, 1–2 cm. in diameter; sheaths longer than the internodes, glabrous, often pruinose; ligule membranous, ciliate, 1–2 mm. long; blades flat, linear, 30–150 cm. long, 10–70 mm. wide, glabrous, smooth, the margins serrulate-scabrous; panicle large, plume-like, 25–60 cm. long, the branches ascending or somewhat spreading; spikelets 3.5–4 mm. long, the callus short-bearded; glumes acuminate, the dorsal surface clothed with long spreading hairs or the second glume sometimes glabrous or nearly so; sterile lemma about equaling the glumes; fertile lemma slightly shorter, the midnerve extending into a short mucro or an awn as much as 1 mm. long; fertile palea about half as long as the lemma.

BRITISH NEW GUINEA: Western Division: Fly River, about 30 miles below Everill Junction, *Brass 6582* (A, US) (in pure stands, 3–5 meters high; occupies many miles of the swampy banks of the middle river); Strickland River, *W. Bauerlen 60* (US).

Indo-Malayan Region to New Guinea.

2. **Erianthus fastigiatus** (Nees ex Steud.) Hack. in DC., Monogr. Phan. 6: 150. 1889.
Saccharum fastigiatum Nees ex Steud., Syn. Pl. Glum. 1: 409. 1855. Type from India.
Erianthus sesquimetralis Ohwi, Bot. Mag. (Tokyo) 56: 9. 1942. Type from Netherlands New Guinea.

Culms subrobust, 150 cm. or more tall, appressed-pilose at the summit, otherwise glabrous; sheaths 20–30 cm. long, appressed-pilose on the margins near the summit, otherwise glabrous; ligule truncate, minutely ciliate, about 0.7 mm. long; blades elongate, 30–80 cm. long, 5–8 mm. wide, rigid, glabrous except for a few hairs at the base; panicle short-exserted, erect, about 15 cm. long, 3–4 cm. wide, the axis clothed with long white hairs; racemes solitary, the lower about 4 cm. long, the rachis pilose with white spreading hairs, the joints about one-third shorter than the spikelets; pedicels rather slender and pilose like the rachis; spikelets lanceolate, about 4 mm. long; glumes acute, reddish brown except for the pale apex; first glume minutely bimucronate, flattened, the lower half near the margins bearing long white hairs; second glume 1-nerved, the lower part of the keel short-pilose; sterile lemma nerveless, slightly shorter than

the glumes, somewhat brownish below, the margins and scarious apex ciliate; fertile lemma about 1.5 mm. long, bidentate and bearing a brownish awn about 7–8 mm. long; palea about half as long as the lemma.

NETHERLANDS NEW GUINEA: Momi, 60 miles south of Manokwari, *Kanehira & Hatusima 13291* (type of *E. sesquimetralis* Ohwi) (fragment at A) (in waste plantation 10 m. above the sea).

The type of *Erianthus fastigiatus* has not been seen, but from the brief description in Steudel, and Hackel's detailed diagnosis, *E. sesquimetralis* seems referable to this species. A fragmentary specimen in the U. S. National Herbarium, from India, which seems to represent this species, has spikelets which are almost identical with those of the New Guinea plant except that the hairs on the first glume are slightly shorter.

28. Eulalia Kunth

Eulalia Kunth, Rev. Gram. 1: 160. 1829.

Pollinia Trin. sect. *Eulalia* (Kunth) Benth. & Hook., Gen. Pl. 3: 1127. 1883.

Pollinia Trin. subgen. *Eulalia* (Kunth) Hack. in DC., Monogr. Phan. 6: 152. 1889.

Spikelets paired, all alike and perfect, one pediceled and falling free from the pedicel, the other sessile and falling with the rachis joint and the pedicel of the upper spikelet (rarely both pediceled and disarticulating obliquely, forming a sharp-pointed callus, the pedicels remaining attached to the tardily disarticulating rachis joints); glumes subequal, the first dorsally flattened or rounded, sometimes slightly grooved, the second more or less keeled on the back, 1–3-nerved, sometimes awned; sterile lemma hyaline, as long as the glumes, reduced, or sometimes wanting; fertile lemma minute, usually reduced to the delicate base of a stout twisted and geniculate awn. Perennials or rarely annuals with usually erect culms, linear blades, and digitate or approximate racemes.

TYPE SPECIES: *Eulalia aurea* (Bory) Kunth (*Andropogon aureus* Bory).

KEY TO THE SPECIES

1. One spikelet pediceled, the other sessile; second glume awnless; rachis readily disarticulating at maturity, the joints falling attached to the sessile spikelet.
   2. Inflorescence golden brown; hairs on the spikelets of the same color, 5–10 mm. long.....2. *E. leptostachys.*
   2. Inflorescence grayish brown; hairs on the spikelets silvery, about 2 mm. long or less.....1. *E. trispicata.*
1. Both spikelets pediceled; second glume with a slender awn 5 mm. or more long; rachis tardily disarticulating, the spikelets falling free from the pedicels.
   3. Spikelets reddish brown, about 0.4 mm. wide; fertile lemma with a twice geniculate awn 3–5 cm. long.....3. *E. irritans.*
   3. Spikelets brownish tan, about 0.7 mm. wide; fertile lemma awnless.....3a. *E. irritans* var. *egregia.*

1. **Eulalia trispicata** (Schult.) Henr., Blumea 3: 453. 1940; Ohwi, Bot. Mag. (Tokyo) 56: 10. 1942.

   Andropogon tristachyos Roxb., Fl. Ind. 1: 261. 1820 (non *A. tristachyus* H.B.K. 1816). Type from India.

   Andropogon trispicatus Schult., Mantissa 2: 452. 1824. Based on *A. tristachyos* Roxb.

   Eulalia argentea Brongn. in Duperry, Bot. Voy. Coquille 2: 92. 1830; Hitchc., Brittonia 2: 125. 1936. Type from the Moluccas.

Pollinia argentea (Brongn.) Trin., Mém. Acad. St. Pétersb. VI. Sci. Nat. 2(1): 90, 1836; Hack. in DC., Monogr. Phan. 6: 162. 1889; K. Schum. & Hollr., Fl. Kais. Wilhelmsland 22. 1889.

Eulalia tristachya (Roxb.) Kuntze, Rev. Gen. 775. 1891; A. Camus, Ann. Soc. Linn. Lyon 68: 203. 1922.

? *Pollinia leptantha* Stapf, Kew Bull. 1909: 266. 1909. Type from Netherlands New Guinea.

Perennial (or sometimes annual?); culms erect, caespitose, 60–100 (rarely to 200) cm. tall, glabrous or slightly pubescent below the inflorescence; sheaths usually glabrous but sometimes pubescent, always more or less pubescent on the collar; ligule about 0.5 mm. long, ciliolate, usually with some longer hairs back of it; blades elongate, 3–5 mm. wide, flat, glabrous beneath, somewhat pilose above, especially near the base; racemes 3–20, digitate or approximate, 5–20 cm. long, the rachis clothed with soft white hairs, the joints about one-fourth shorter than the spikelet; pedicels slightly shorter than the rachis joint and bearing similar hairs; spikelets 2.5–3.5 (rarely to 4.5) mm. long; glumes equal, reddish brown, the first dorsally flattened, 2-nerved, the apex rounded; second glume 3-nerved, somewhat keeled; both glumes clothed with spreading white hairs, especially toward the margins, the hairs often 1 mm. long or more; sterile lemma about equaling the glumes, ciliate; fertile lemma 1.5–2 mm. long, bifid, the teeth often 1 mm. long, awned from between the teeth, the awn twisted and geniculate, 5–10 mm. long.

BRITISH NEW GUINEA: Western Division: Wuroi, Oriomo River, alt. 10–30 m., *Brass 5710* (A, US) (common on poorly drained grey soil of savannah ridges); Dagwa, Oriomo River, alt. 40 m., *Brass 5926* (A, US) (the principal grass on damp soil on open ridges); Lake Daviumbu, Middle Fly River, *Brass 7809* (A, US) (occasional in large tufts on savannahs), *Brass 7950* (A, US) (occasional on wet savannah plains); Gaima, Lower Fly River, *Brass 8279* (A, US) (occasional clumps on savannahs); Tarara, Wassi Kussa River, *Brass 8566* (A, US) (occasional tufts in savannah-forests), *Brass 8697* (A, US) (in native villages and gardens); Central Division: Sogeri, near Port Moresby, *L. S. Smith N. G. 98* (A) (in open forest); Northern Division: About 3½ miles south of Dobodura, *Reeder 821* (A, US) (in open grassland).

India to Australia, New Guinea, and Polynesia.

No type material of *Pollinia leptantha* was available, but from the description and study of numerous specimens of *Eulalia trispicata* from India to New Guinea, it does not appear to be distinct from that species.

2. **Eulalia leptostachys** (Pilger) Henr., Blumea 3: 453. 1940; Chase, Jour. Arnold Arb. 24: 88. 1943.

Pollinia leptostachys Pilger, Bot. Jahrb. 52: 170. 1914. Type from New Guinea.

Pollinia Cumingii sensu K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 166. 1901. (Specimen cited is type of *P. leptostachys*.)

Perennial with scaly rhizomes; culms 40–70 cm. tall, erect or ascending, the base sometimes geniculate, appressed-white-pubescent below the inflorescence, otherwise glabrous; sheaths subglabrous to more or less pubescent, always more or less pilose at the throat; ligule about 0.5 mm. long, ciliolate; blades linear-lanceolate, 6–15 (rarely 20) cm. long and as much as 10 mm. wide, glabrous to more or less short-pubescent, the margins scabrous, the base abruptly narrowed into a very short petiole at the junction with the sheaths; panicle contracted, the branches, pedicels, and spikelets covered with gold-brown hairs; axis 2–4 cm. long, bearing

4–10 densely flowered racemes, about 8–10 cm. long; spikelets 3–4 mm. long, bearing spreading brown hairs about twice their length; first glume somewhat flattened and 2-keeled toward the apex, truncate, erose, and stiffly short-ciliolate, usually 2–4-nerved, sometimes also with a midnerve; second glume 1–3-nerved, obscurely keeled, the apex truncate-obtuse, ciliolate; sterile lemma usually wanting; fertile lemma minute, bifid, the slender lobes ciliate; awn 1–2 cm. long, the base weakly twisted and geniculate, the bend less than 1 mm. above the apex of the spikelet.

BRITISH NEW GUINEA: North Eastern Division: Mount Obree, alt. about 2000 m., *W. S. Sawyer 76* (US). NORTHEAST NEW GUINEA: Morobe District: Ogeramnang, alt. about 1700 m., *Clemens 4725* (A); Kajabit Mission, alt. about 600 m., *Clemens 10867* (US) (open place at foot of mountain). NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass 10901* (A, US) (a few tufts on a dry open landslip in forest); Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11363* (A, US) (covering light gravelly [formerly forested] banks of river); Balim River, alt. 1600 m., *Brass 11825* (A, US) (locally abundant on long deforested slopes).

Endemic.

Eulalia leptostachys is related to both *E. Cumingii* (Nees) A. Camus and *E. fulva* (R. Br.) Kuntze, but it differs from both in having the panicle composed of longer, more numerous racemes, and spikelets with an awn which is only weakly twisted and geniculate, the bend occurring just above the tips of the glumes. *Eulalia fulva* has thick woolly culm bases and very thick racemes. *Eulalia Cumingii* has slender, creeping stolons, and the racemes are short and very slender. Both these species have been reported from New Guinea, but I have seen no specimens. They may represent misidentifications for *E. leptostachys*.

3. **Eulalia irritans** (R. Br.) Kuntze, Rev. Gen. 2: 775. 1891; Hitchc., Brittonia 2: 126. 1936.

Saccharum irritans R. Br., Prodr. Fl. Nov. Holl. 1: 203. 1810. Type from Australia.

Erianthus irritans (R. Br.) Kunth, Rev. Gram. 1: 160. 1829.

Pollinia irritans (R. Br.) Benth., Fl. Austral. 7: 525. 1879; Hack. in DC., Monogr. Phan. 6: 155. 1889.

Pseudopogonatherum irritans (R. Br.) A. Camus, Ann. Soc. Linn. Lyon 68: 205. 1921.

Annual; culms erect, 6–8-noded, glabrous, 60–100 cm. tall; sheaths glabrous, usually shorter than the internodes; ligule about 0.5 mm. long, minutely ciliolate; blades involute, attenuate, as much as 50 cm. long, glabrous below, glaucous and often more or less pubescent above, especially toward the base; panicle 10–15 cm. long, the common axis about 3 cm. long; racemes numerous, erect or ascending, the rachis very tardily disarticulating, about 0.4 mm. wide, the margins stiff-long-ciliate, the hairs longest toward the ends of the joints; spikelets reddish brown, more or less white-pilose, 2.5–3 mm. long, about 0.4 mm. wide (including the callus 3.5–4 mm. long), both alike and pediceled, the longer pedicel 2–2.5 mm., the shorter about 1 mm. long, the pedicels bearing hairs similar to those of the rachis; both spikelets disarticulating obliquely from the pedicels and forming a sharp callus bearing a tuft of stiff white hairs about half as long as the spikelet; glumes subequal, the first 2-nerved, rounded or flattened on the back, the apex minutely bidentate; second

glume 1–3-nerved, slightly keeled on the back, midnerve extending into a slender flexuous awn 5–7 mm. long with a short offset double bend at the base; sterile lemma wanting; fertile lemma narrow, hyaline, bearing a stout twice-geniculate awn, 3–5 cm. long, the lower half brown, twisted, and bearing white hairs 1.5–2 mm. long, the upper half pale and slender; anthers about 1 mm. long.

BRITISH NEW GUINEA: Western Division: Wuroi, Oriomo River, *Brass 5733* (A, US) (scattered on low grey soil of savannah ridges); Mabaduan, *Brass 6524* (A, US) (rare grass in savannah forests); Lake Daviumbu, Middle Fly River, *Brass 7645* (A, US) (not common in savannahs in this locality); Gaima, Lower Fly River, *Brass 8251* (A, US) (open savannah forests, not common); Central Division: Port Moresby to Kalo, *MacGregor 53* (US); South Eastern Division: *Chalmers 71* (US).

Australia and New Guinea to the Philippines.

3a. **Eulalia irritans** (R. Br.) Kuntze var. **egregia** var. nov. PLATE VII, *Figs. d, e.*

A typo lemmate fertili mutica, spiculis latioribus et paullo longioribus, arista glumae secundae longioribus et paullo crassioribus, pedicellis paullo longioribus differt.

BRITISH NEW GUINEA: Western Division: Wai Kussa River, *MacGregor 8* (US, TYPE), 1890.

The most striking character of this variety is the absence of the awn on the fertile lemma (one spikelet at the base of one of the racemes had an awn 30 mm. long, twice geniculate, and similar in other respects to those of the species; all other spikelets were without such awns). Further differences are seen in the spikelets, which are of a lighter brown color, noticeably broader and slightly longer, the awn of the second glume being somewhat longer and not so slender; the anthers are about 1.5 mm. long as compared with 1 mm. for *E. irritans*, and the pedicels are 1.5–2 mm. and 3 mm. long rather than 1 mm. and 2–2.5 mm. as in the species. Unfortunately only one specimen was available for study. With additional collections this form may prove to be a distinct species.

29. **Microstegium** Nees

Microstegium Nees in Lindl., Nat. Syst. 447. 1836.

Pollinia Trin., Mém. Acad. St. Pétersb. VI. 2: 304. 1832 (non Spreng. 1815).

Leptatherum Nees, Proc. Linn. Soc. 1: 92. 1841.

Spikelets in pairs, one sessile or subsessile, the other pediceled, both alike and perfect or the upper sometimes reduced, falling free from the pedicel, the lower spikelet falling with the joint of the rachis and the pedicel of the upper spikelet; glumes chartaceous or membranous, the first usually distinctly dorsally grooved, the second laterally compressed, cymbiform; sterile lemma wanting or rarely well developed, sometimes bearing a staminate flower; fertile lemma small, often reduced to a narrow base of a straight or twisted awn. Mostly annuals with straggling culms, lanceolate blades usually narrowed into short petioles, and few to many digitate or approximate racemes.

TYPE SPECIES: *Microstegium Willdenowianum* Nees = *M. vimineum* (Trin.) A. Camus (*Andropogon vimineus* Trin.).

KEY TO THE SPECIES

1. Rachis joints ciliate, shorter than the sessile spikelet; sterile lemma wanting or very much reduced.
   2. Blades 15–25 mm. wide; racemes 15–40.....1. *M. spectabile.*
   2. Blades mostly 4–12 mm. wide; racemes 2–10.....2. *M. ciliatum.*
1. Rachis joints glabrous, very slender, equaling or exceeding the sessile spikelet; sterile lemma about as long as the glumes.....3. *M. nudum.*

1. **Microstegium spectabile** (Trin.) A. Camus, Ann. Soc. Linn. Lyon 68: 200. 1921; Hosakawa, Jour. Soc. Trop. Agr. 7: 310. 1935.

Pollinia spectabilis Trin., Mém. Acad. St. Pétersb. VI. 2: 305. 1832; Hack. in DC., Monogr. Phan. 6: 174. 1889, Bot. Jahrb. 13: 260. 1890. Type from the Carolines.

Pollinia pleiostachya Lauterb. & K. Schum. in K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 168. 1901. Type from Northeast New Guinea.

Microstegium pleiostachyum (Lauterb. & K. Schum.) A. Camus, Ann. Soc. Linn. Lyon 68: 200. 1921.

Culms prostrate, branching, more than a meter long, firm, glabrous throughout or the lower nodes sometimes minutely bearded; sheaths striate, keeled above, glabrous or more or less papillose-pilose near the margins, the upper margins extending into slight auricles 1.5–2 mm. long connected by the membranous ligule; blades lanceolate, 10–18 cm. long, 15–25 mm. wide, the midrib whitish and prominent below, glabrous, the margins scabrous; apex acuminate, the base narrowed into a short petiole about 2 mm. long; panicle 8–14 cm. long, composed of 15–40 approximate racemes; rachis slender, bristly-ciliate on the margins, the joints slightly shorter than the subsessile lower spikelets, the pedicel about three-fourths as long as the rachis joint, also bristly-ciliate; lower spikelet 3–3.5 mm. long, the callus short-bearded; first glume obscurely 4-nerved (sometimes with a midnerve), the margins scabrous-pectinate toward the acuminate entire or minutely bifid apex; second glume 1–3-nerved, acuminate or aristulate, the prominent keel scabrous-pectinate; sterile lemma wanting; fertile lemma minute, bearing a slender capillary weakly twisted awn 1–3 times as long as the spikelet; anthers 1.5–2 mm. long; the upper spikelet similar but slightly smaller, the nerves of the glumes often more prominent.

BRITISH NEW GUINEA: Central Division: Koitaki, *Carr 12236* (US) (in forest). NORTHEAST NEW GUINEA: Morobe District: Boana, alt. about 1000 m., *Clemens 41715* (US). NETHERLANDS NEW GUINEA: 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13720* (A, US) (occasional in young seral rain-forest on sandy flood banks).

The Carolines to New Guinea and the Philippines.

Closely related to *Microstegium gratum* (Hack.) A. Camus, but differing in having glabrous culms, sheaths often papillose-pilose on the margins, and much more numerous racemes. *Microstegium gratum* has culms pubescent below the nodes and inflorescence, the awn of the fertile lemma stout and distinctly geniculate, and anthers about 3 mm. long. The Brass specimen was cited as *M. gratum* by Chase (18, p. 88). The specimens cited as *Pollinia grata* Hack. by Ridley (62, p. 249) and White (75, p. 15) may also represent *M. spectabile.* I have seen no specimens of *M. gratum* from New Guinea.

2. **Microstegium ciliatum** (Trin.) A. Camus, Ann. Soc. Linn. Lyon 68: 201. 1921.

Pollinia ciliata Trin., Mém. Acad. St. Pétersb. VI. 2: 306. 1832. Type from India.

Culms slender, 60–100 cm. tall, glabrous or the nodes sometimes puberulent; sheaths shorter than the internodes, glabrous or rarely pilose near the margins, the hairs sometimes papillose-based; ligule membranous, brownish, puberulent, 1–2 mm. long; blades linear-lanceolate, 5–10 cm. long, 4–10 (rarely to 15) mm. wide, acuminate, the base narrowed into a short petiole; racemes 2–10, 4–8 cm. long, approximate, the rachis ciliate, readily disarticulating, the joints slightly shorter than the spikelets; sessile spikelets 3–4.5 mm. long; first glume dorsally grooved, acute or bidentate; second glume acute or with a short awn; sterile lemma minute or wanting; fertile lemma minute, bearing a well developed awn; anthers about 1.5 mm. long.

2a. **Microstegium ciliatum** (Trin.) A. Camus var. **laxum** (Nees ex Steud.) comb. nov.

Pollinia laxa Nees ex Steud., Syn. Pl. Glum. 1: 401. 1854. Type from India.

Andropogon breviaristatus Steud., Syn. Pl. Glum. 1: 397. 1854. Based on *P. laxa*.

Pollinia ciliata Trin. var. *laxa* (Nees ex Steud.) Hack. in DC., Monogr. Phan. 6: 176. 1889.

Microstegium breviaristatum (Steud.) Keng, Sinensia 3: 92. 1932.

Microstegium ciliatum (Trin.) A. Camus var. *latifolium* Ohwi, Bot. Mag. (Tokyo) 56: 10. 1942. Type from Netherlands New Guinea.

Differing from the species in having rachis joints only shortly ciliate, the first glume bidentulate, and the second glume bearing a capillary awn 1–4 mm. long; awn of the fertile lemma slender, flexuous, 8–20 mm. long.

NETHERLANDS NEW GUINEA: Waren, 60 miles south of Manokwari, *Kanehira & Hatusima 13243* (A, type collection of *M. ciliatum* var. *latifolium*) (in rain-forest).

3. **Microstegium nudum** (Trin.) A. Camus, Ann. Soc. Linn. Lyon 68: 201. 1921.

Pollinia nuda Trin., Mém. Acad. St. Pétersb. VI. 2: 307. 1832; Hack. in DC., Monogr. Phan. 6: 178. 1889. Type from India.

Eulalia nuda (Trin.) Kuntze, Rev. Gen. 2: 775. 1891.

Culms very slender, decumbent and rooting at the nodes; sheaths glabrous or minutely pubescent, the margins often ciliate; ligule membranous, about 0.2 mm. long; blades lanceolate or linear-lanceolate, 1.5–6 cm. long, 4–8 mm. wide, glabrous or the upper surface bearing scattered short papillose-based hairs; racemes 3–6, borne on a slender glabrous axis 6–12 mm. long; rachis slender, trigonous, glabrous, the joints about one and one-half times longer than the sessile spikelet, the slender glabrous pedicels one-third to half as long as the rachis joints; spikelets narrowly lanceolate, about 4 mm. long, glabrous except for the very short hairs on the callus; first glume 4–6-nerved, acute or bidentulate; second glume 1–3-nerved, minutely aristulate, prominently keeled on the back; sterile lemma hyaline, nerveless, about as long as the glumes; fertile lemma about one-fourth shorter, 1-nerved, the nerve extending into a very slender flexuous awn 8–15 mm. long.

NORTHEAST NEW GUINEA: Morobe District: Samanzing, alt. about 1600 m., *Clemens 10279* (US) (on steep open trail).

India to Japan, Formosa, and Malaysia.

30. **Pogonatherum** Beauv.

Pogonatherum Beauv., Ess. Agrost. 56. *pl. 11, fig. 7.* 1812.

Spikelets paired, one sessile and perfect, the other pediceled and pistil-

late, falling free from the pedicel, the sessile spikelet falling with the rachis joint and the pedicel of the upper spikelet; glumes membranous, subequal, the first 3-nerved, truncate, ciliate, the second 1-nerved, keeled and bearing a long slender awn from just below its bifid apex; lemmas hyaline, the sterile empty or wanting, the fertile bifid and bearing a long slender awn equaling or exceeding that of the second glume; stamens 2 or 1. Rather low and slender perennials with terminal solitary spikelike racemes.

TYPE SPECIES: *Pogonatherum saccharoideum* Beauv. = *P. paniceum* (Lam.) Hack. (*Saccharum paniceum* Lam.).

1. **Pogonatherum paniceum** (Lam.) Hack., Allg. Bot. Zeitschr. 12: 178. 1906; Hitchc., Proc. Linn. Soc. N. S. Wales 54: 145. 1929.

Saccharum paniceum Lam., Encycl. 1: 595. 1783, Illustr. 1: *pl. 40, fig. 3.* 1791. Type from India.

Andropogon crinitum Thunb., Fl. Jap. 40. *pl. 7.* 1784. Type from Japan.

Pogonatherum saccharoideum Beauv., Ess. Agrost. 56, 176. *pl. 11, fig. 7.* 1812; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 168. 1901. Based on *Saccharum paniceum* Lam.

Pogonatherum crinitum (Thunb.) Kunth, Enum. 1: 478. 1833; Hack., Denkschr. Akad. Wiss. Math.-Naturw. (Wien) 89: 492. 1913.

Culms densely tufted, 15–40 cm. tall, delicate or somewhat coarse, the nodes often white-bearded; sheaths usually long-pilose in the throat, the margins often ciliate; ligule white, membranous, puberulent, about 0.5 mm. long; blades 2–5 cm. long, 1–4 mm. wide, flat or sometimes involute, often scabrous above; racemes solitary, 15–30 mm. long, slender, whitish or yellowish, the rachis joints and pedicels white-villous, about half as long as the spikelets; spikelets 2.5–3 mm. long, the callus hairs as long as the spikelets or shorter; first glume 3-nerved, the truncate apex ciliate; second glume laterally compressed, keeled, 1-nerved, the nerve extending into a long slender awn; sterile lemma shorter than the glumes (sometimes wanting), nerveless; fertile lemma shorter than the glumes, 1-nerved, long-awned from the bifid apex; palea often as long as the lemma; stamens usually 2 (sometimes 1), the anthers about 1.5 mm. long; awns of the second glume and fertile lemma similar, about 10 mm. long.

BRITISH NEW GUINEA: Central Division: Budotobara, *Brass 768* (GH, US) (wet rock crevices); Mafulu, alt. 580 m., *Brass 5270* (GH, US) (crevices in river-bed rocks); Kanosia, *Carr 11345* (US, NY) (river banks, low down and subject to frequent flooding); Eastern Division: Kurandi, *Brass 1391* (GH, US) (small grass in crevices of river-bed rocks); Western Division: Fly River, *Wm. Bauerlen 43* (US); Fly River, 528-mile camp, alt. 80 m., *Brass 6810* (A, US) (occasional on rocky river banks swept by floods); Lower Fly River opposite Sturt Island, *Brass 8220* (A, US) (tufted on moist cliff face). NORTHEAST NEW GUINEA: Morobe District: *Clemens 6548a* (A); Kajabit, Markham Valley, *Clemens 10552* (US); near Finschhafen, *Reeder 886* (A, US) (growing in cracks of rocks above a waterfall in a small stream, abundant in this location). NETHERLANDS NEW GUINEA: Hollandia, *T. C. Baim* (sine no.) in 1945 (A) (dry gravelly bank of stream); Bele River, 18 km. northeast of Lake Habbema, alt. 2350 m., *Brass 11568* (A, US) (abundant on a precipitous limestone slope); Balim River, alt. 1600 m., *Brass 11631* (A, US) (abundant on dry rocky ground on deforested slopes); 4 km. southwest of Bernhard Camp, Idenburg River, alt. 850 m., *Brass 13479* (A, US) (abundant on a flood-swept rocky river bank); Rouffaer River, alt. about 175 m., *Docters van Leeuwen 9995* (GH, NY). SOLOMON ISLANDS: San

Cristoval: Hao River, *Brass 2893* (GH) (rock crevices on the river bank; common); Ysabel: Maruto, alt. 300 m., *Brass 3386* (GH) (on rocks in river bed, common).

Eastern Asia, Malaysia to Australia and New Guinea.

A very distinctive little grass, usually to be found growing in rock crevices along rivers. Easily recognized by its short, solitary, yellowish panicles with 2-awned spikelets.

31. **Sclerandrium** Stapf & C. E. Hubb.

Sclerandrium Stapf & C. E. Hubb., Hook. Ic. 33: *pl. 3262*. 1935.

Spikelets paired, dimorphic, one pediceled, the other sessile, the pairs alternately arranged along a slender, not or tardily disarticulating rachis; sessile spikelet more or less persistent on the rachis, dorsally compressed, bearing two staminate flowers; first glume indurated, shorter than the second, the apex truncate, emarginate or dentate; second glume membranous, obtuse to truncate, as long as the spikelet; lemmas hyaline, the lower obtuse, the upper mucronate or awned, stamens 2; pediceled spikelet readily disarticulating from the pedicel, bearing one perfect flower; glumes equal, coriaceous; fertile lemma bearing a long geniculate awn; stamens 2; pistil with a distinct style and two long plumose stigmas. Perennials with flat linear blades and 2–several digitate or approximate racemes.

TYPE SPECIES: *Sclerandrium truncatiglume* (F. Muell. ex Benth.) Stapf & C. E. Hubb. (*Ischaemum truncatiglume* F. Muell. ex Benth.).

1. **Sclerandrium truncatiglume** (F. Muell. ex Benth.) Stapf & C. E. Hubb., Hook. Ic. 33: *pl. 3262*. 1935; Chase, Jour. Arnold Arb. 20: 314. 1939.

Ischaemum truncatiglume F. Muell. ex Benth., Fl. Austral. 7: 518. 1878. Type from Australia.

Culms caespitose, 3–5-noded, 80–150 cm. tall, glabrous; sheaths firm, shorter than the internodes, glabrous or slightly pilose in the throat; ligule membranous, about 1 mm. long; blades as much as 50 cm. long, 5–10 mm. wide, acuminate, the base attenuate, the upper surface sparsely pilose toward the base, otherwise glabrous; racemes 3–6, erect, 8–12 cm. long, the common axis about 1.5 cm. long; rachis slender, pilose, the internodes about 3 mm. long; sessile spikelets 5–6.5 mm. long; first glume 3.5–5 mm. long, truncate to 2–3-toothed, smooth and shining on the back, ciliate with white hairs 1–2 mm. long on the margins and apex, inside 5–7-nerved, the nerves anastomosing below the apex; second glume short-appressed-pilose, the hairs longer on the margins and toward the apex; lower lemma lanceolate, 4–5 mm. long, the palea similar but slightly wider, both more or less pubescent; upper lemma slightly shorter than the fertile, the apex bearing an awn up to 3 mm. long, the lemma and slightly longer palea more or less pubescent; pediceled spikelet 3–3.6 mm. long, the slender pilose pedicel about 2 mm. long, the spikelet disarticulating obliquely with a sharp-pointed brown hairy callus; glumes brown, pilose, with spreading whitish hairs about 1 mm. long; fertile lemma with an awn 16–25 mm. long, the column 5–9 mm. long, spreading-pilose with white hairs about 1 mm. long.

BRITISH NEW GUINEA: Western Division: Tarara, Wassi Kussa River,

Brass 8537 (A, US) (uncommon on savannah-forest ridges), *Brass 8665* (A, US) (occasional on banks of streams in savannah forest).

Australia and New Guinea.

32. Ischaemum L.

Ischaemum L., Sp. Pl. 1049. 1753, Gen. Pl. ed. 5. 469. 1754.
Meoschium Beauv., Ess. Agrost. 111. *pl. 21, fig. 4.* 1812.

Spikelets paired, one sessile or subsessile and perfect, falling with the rachis joint and the pedicel of the upper spikelet, the other pediceled, staminate or perfect, falling free from the pedicel; rachis joints and pedicels trigonous or rarely convex on the back, usually ciliate along the edges; glumes firmly indurate, the first flat or slightly rounded on the back, the margins inflexed; second glume cymbiform, keeled on the back or rarely rounded, the apex acuminate or aristate; sterile lemma membranous or hyaline, enclosing a palea and a staminate flower; upper floret perfect or pistillate, the lemma hyaline, usually 2-cleft and awned from the base of the cleft; first glume of the pediceled spikelet often with one margin strongly inflexed, the glume thus appearing laterally compressed. Annuals or perennials with usually binate or digitate (rarely solitary) racemes.

TYPE SPECIES: *Ischaemum muticum* L.

KEY TO THE SPECIES

1. Racemes solitary or binate.
   2. Racemes binate, often closely appressed and appearing as a solitary cylindrical spike; rachis joints and pedicels trigonous.
      3. Culms prostrate, creeping; fertile lemma mucronate or with a short straight (3 mm. long or less) awn from the apex.....3. *I. muticum.*
      3. Culms erect or ascending; fertile lemma deeply cleft and bearing a geniculate and twisted awn from the base of the cleft.
         4. Plants 60–150 cm. tall; first glume of pediceled spikelet acute or bifid, not aristate.
            5. Sessile spikelet (including the callus) 7–9 mm. long; rachis joints about 5 mm. long; first glume stramineous or brownish.....1. *I. aristatum.*
            5. Sessile spikelet (including the callus) about 6 mm. long; rachis joints about 4 mm. long; first glume purple-flecked.....2. *I. pubescens.*
         4. Plants 20–40 cm. tall; both glumes of pediceled spikelet aristate; callus yellow-bearded.
            6. Second glume of the sessile spikelet with an awn 5–6 mm. long; glumes of the pediceled spikelets long-pilose on the keels, aristate, the awns 3–4 mm. long.....4. *I. foliosum.*
            6. Second glume of the sessile spikelet with an awn only 1–2 mm. long; glumes of the pediceled spikelets scabrous on the keels, short-aristate, the awns only 0.5–1 mm. long.....5. *I. littorale.*
   2. Racemes solitary; rachis joints and pedicels hemispheric-convex on the back, the inner cavity closed by a thin hyaline membrane.....9. *I. fragile.*
1. Racemes 3–7, digitate or approximate.
   7. Sessile spikelet with a well developed geniculate and twisted awn; first glume stramineous or brownish.
      8. Sessile spikelet with a geniculate awn; pediceled spikelet mucronate or with a short straight awn.....7. *I. digitatum.*

8. Both sessile and pediceled spikelets with well developed geniculate awns.... .....8. *I. intermedium.*

7. Sessile spikelet with a straight awn 5–6 mm. long; pediceled spikelet awnless; first glume purple-flecked.....6. *I. Turneri.*

1. **Ischaemum aristatum** L., Sp. Pl. 1049. 1753; Blatter & McCann, Imp. Council Agric. Res. Sci. Monogr. 5: 11–12, *pl. 6.* 1935; Hitchc., Brittonia 2: 126. 1936. Type from China.

Ischaemum arundinaceum F. Muell. ex Benth., Fl. Austral. 7: 519. 1878; Chase, Jour. Arnold Arb. 20: 313. 1939. Type from Australia.

Culms erect or decumbent at base, 60–150 (sometimes to 200) cm. tall, stout or rather slender, the internodes often pruinose; nodes glabrous or bearded; sheaths keeled above, usually glabrous, the margins extending into auricles 3–6 mm. long connected by the membranous, often somewhat shorter ligule; blades linear-lanceolate, 10–30 cm. long, 8–15 (rarely to 20) mm. wide, acuminate, the base sometimes rounded or subcordate but more often gradually tapering, usually glabrous on both surfaces (rarely somewhat pubescent), the margins scabrous; racemes 2, erect, usually closely appressed and appearing more or less as one cylindrical spike, 5–15 cm. long; rachis joints about 5 mm. long, 3-angled and ciliate on the angles; pedicels somewhat shorter, similar to the rachis joint and parallel to it; sessile spikelets stramineous or brownish, oblong, 7–9 mm. long including the bearded callus; first glume nearly smooth to more or less prominently rugose below, striate above, the keels winged; fertile lemma cleft to the middle and bearing from the base of the cleft a twisted and geniculate awn 10–15 mm. long; pediceled spikelets slightly shorter, usually broadly winged along the external keel, awnless.

BRITISH NEW GUINEA: Western Division: Wuroi, Oriomo River, alt. 10–30 m., *Brass 5726* (GH, US) (common amongst bushy growth on fringe of forest); Lake Daviumbu, Middle Fly River, *Brass 7900* (A, US) (dominating [often the only grass] over large areas of low savannah and wet grass plains); Lower Fly River, *Brass 8259* (A, US) (common in savannah forests); Tarara, Wassi Kussa River, *Brass 8751* (A, US) (not common in savannah forests).

India to China, the Philippines, Malaysia, New Guinea, to Australia.

Typical *Ischaemum aristatum* from China has the lower part of the first glume prominently transversely rugose or at least with rather prominent marginal undulations. In *I. arundinaceum* from Australia the first glume is smooth or with only weak undulations on the margins. In all other respects these two species are practically indistinguishable. Since there is no other character on which to separate these "species" except the presence or absence of undulations on the first glume, and in that it seems to be a matter only of degree, they are considered here to be components of one variable species. The New Guinea material varies from having the first glume smooth to rather noticeably undulate.

1a. **Ischaemum aristatum** L. subsp. **barbatum** (Retz.) Hack. in DC., Monogr. Phan. 6: 204. 1889; Chase, Jour. Arnold Arb. 20: 314. 1939.

Ischaemum barbatum Retz., Obs. Bot. 6: 35 [error for 25]. 1791. Type from Java.

Differing from the species in having sessile spikelets more or less dorsally villous, and pediceled spikelets glabrous or villous. The sheaths are often pilose.

BRITISH NEW GUINEA: Western Division: Dagwa, Oriomo River, alt. 40 m., *Brass 5928* (A, US) (forming large patches on open slopes); Gaima, Lower

Fly River, *Brass 8260* (A, US) (occasional in savannah forest grass cover); Daru Island, *Brass 6040* (GH, US) (very abundant on wet savannahs of center of Island), *Brass 6253* (A, US) (frequent in tall grass cover of savannah forests). NETHERLANDS NEW GUINEA: Hollandia and vicinity, alt. 20–100 m., *Brass 8815* (A, US) (covering extensive deforested slopes in association with *Gleichenia* sp. or in pure stands).

Indo-Malayan region to New Guinea.

This subspecies is distinguishable on no other character than the pilose first glume. I suspect that this is not reliable and that plants may be pilose when young and become glabrous in age. *Ischaemum barbatum* Retz. var. *arfakense* (Rendle) Ohwi (56, p. 11) is probably this subspecies. *Brass 6040* has exceptionally hairy sheaths and was reported as *I. aristatum* var. *Meyenianum* (Nees) A. Camus, by Hitchcock (35, p. 126). *Brass 8260* was reported as *I. pubescens* by Chase (17, p. 314).

2. **Ischaemum pubescens** Merr., Philip. Jour. Sci. Bot. 9: 264. 1914. Type from the Philippines.

Perennial; culms glabrous, pruinose below the nodes, 70–100 cm. tall, the nodes bearded; sheaths rather loose, the lower softly pilose, the upper more or less glabrous, the margins extending into auricles 2–3 mm. long connected by the brown hyaline ligule; blades softly pilose on both surfaces, the margins scabrous, 10–18 cm. long, 6–12 mm. wide, acuminate, the base of the upper rounded, of the lower gradually narrowed; racemes 2, closely appressed, 6–10 cm. long, long-exserted; rachis joints about 4 mm. long, 3-angled, ciliate-pilose on the angles; pedicels similar, about 3 mm. long; sessile spikelets oblong, about 6 mm. long including the callus, 1.8 mm. wide, the callus white-bearded; first glume indurate, the base with two obscure undulations, the upper half winged, the wings serrulate-scabrous, the back purple-flecked and usually bearing a few scattered hairs; second glume keeled on the back, indurate like the first; lemmas hyaline, the sterile entire, the fertile cleft to the middle and bearing in the cleft a geniculate twisted awn 8–13 mm. long; pediceled spikelets of about the same size and color as the sessile, the first glume sparingly pilose on the back, broadly winged on one side, the wing serrulate scabrous.

NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11617* (A, US) (one of the most abundant grasses on deforested slopes), *Brass 11732* (A, US) (very abundant, sometimes dominant on sandy soil of deforested slopes).

Philippines, New Guinea.

Closely allied to *Ischaemum aristatum* L. subsp. *barbatum* (Retz.) Hack. but distinguishable by its smaller spikelets with the first glume purplish-flecked rather than stramineous, the shorter rachis joints, and the pilose blades.

3. **Ischaemum muticum** L., Sp. Pl. 1049. 1753; K. Schum., Bot. Jahrb. 9: 197. 1887; Hack. in DC., Monogr. Phan. 6: 212. 1889. Type from India.

Perennial; culms long-prostrate, glabrous and often pruinose, the ascending flowering branches 15–50 cm. tall; upper sheaths overlapping, the lower shorter than the internodes, glabrous to more or less papillose-villous toward the margins; ligule membranous, truncate, glabrous or ciliolate, 0.5–1 mm. long; blades linear-lanceolate to lanceolate, 6–12 cm. long, 5–15 mm. wide, the base cordate and with a petiole about 1 mm. long; racemes 2, usually partly included in the upper sheaths, 2.5–4 cm. long;

rachis joints 3-angled, stout, about half as long as the sessile spikelet, the angles glabrous, scabrous, or sometimes short ciliate; pedicels about as long as the rachis joint, similar but usually slightly more slender; sessile spikelet glabrous, smooth and shining, 7–9 mm. long including the 1.5–2 mm. long callus; glumes firmly indurate, the first obovate-lanceolate, the apex acute or shortly bidentate, the keels on the upper half with broad membranous wings; second glume prominently wing-keeled, acute or shortly aristate; sterile lemma chartaceous, the margins with a hyaline wing toward the apex, the palea of like texture but slightly longer; fertile lemma membranous, mucronate or with an awn as much as 3 mm. long, the palea of like texture; pediceled spikelet about 6 mm. long, perfect or rarely sterile.

BRITISH NEW GUINEA: Central Division: Hula, *Brass 514* (GH, US) (a sand binding grass; just above tide mark); Hisiu, *Carr 11413* (NY) (sandy beach); Eastern Division: Bomgwina, *Brass 1616* (GH, US) (common beach grass); Gulf Division: Vailala, *Brass 1177* (GH, US) (very common on the beaches); Western Division: Coast between Oriomo and Fly Rivers, *Brass 6410* (A, US) (abundant as a sand binder on beaches). NORTHEAST NEW GUINEA: Morobe District: Finschhafen, *Weinland 347* (US). NEW BRITAIN: *R. Parkinson 47* (US); Rabaul, *Herre 185* (NY) (seashore). SOLOMON ISLANDS: San Cristoval: Waimamura, *Brass 2646* (GH) (on cleared land near the sea, abundant).

India to Australia, New Guinea and many Pacific Islands.

4. **Ischaemum foliosum** Hack. in DC., Monogr. Phan. 6: 222. 1889. Habitat in New Ireland and New Caledonia.

Ischaemum murinum var. *spiculis majoribus* Balansa, Bull. Soc. Bot. France 19: 323. 1872. Habitat in New Caledonia.

Culms rather slender, ascending from creeping bases, 20–30 cm. tall, the nodes bearded with ascending white hairs 3–5 mm. long; sheaths longer than the internodes, slightly keeled above, toward the margins papillose-pilose with white hairs 4–5 mm. long; ligule membranous, ciliate, 0.5–1 mm. long; blades linear to sublanceolate-linear, 4–8 cm. long, 4–7 mm. wide, acuminate, narrowed toward the base, glabrous below, the upper surface somewhat glaucous and papillose-pilose toward the base; racemes binate, about 3 cm. long; rachis joints and pedicels trigonous, rather stout, 2.5–3 mm. long, the angles ciliate with yellow hairs 2–3 mm. long, the callus densely bearded with similar hairs; sessile spikelet lanceolate, about 6 mm. long including the callus; first glume acuminate, bimucronate, the basal part glabrous, the upper two-thirds scabrous, the narrow keel wings ciliolate-scabrous; second glume equal to the first, somewhat rounded on the back, bidentate, bearing from between the teeth an awn 5–6 mm. long; sterile lemma slightly shorter than the glumes; fertile lemma bifid, the teeth 1–1.5 mm. long, awn 18–20 mm. long, the column about 6 mm. long; pediceled spikelet with both glumes long-pilose on the keels, aristate, the awn 3–4 mm. long; awn of the upper lemma like that of the sessile spikelet.

New Ireland to New Caledonia.

The only specimen seen was a duplicate of the second specimen cited in the original description (*Balansa 707*).[19] The description was drawn up

[19] Specimen from the Hackel Herbarium in Vienna now deposited in the United States National Herbarium.

from this plant and from Hackel's original description. Included in this paper since the first cited specimen was from New Ireland.

5. **Ischaemum littorale** sp. nov. PLATE VII. *Figs. a-c.*

Perennis 20–40 cm. alta; culmis glabris, caespitosis, erectis vel adscendentibus; nodis supra albo-barbatis, inferne demum glabratis; vaginis supra carinatis, quam internodiis plerumque longioribus, papilloso-pilosis, pilis laxis et longis; ligula membranacea, ciliolata, circiter 1 mm. longa; laminis planis vel plus minusve involutis, 3–8 cm. longis, 2–4 mm. latis, acuminatis, basin versus leviter angustatis, subtus scabris, supra papilloso-pilosis, pilis albis, laxis, marginibus glabris vel apicem versus scabris; racemis binatis, longe exsertis, 2–4 cm. longis; articulis pedicellisque subaequalibus, trigonis, 2.5–3 mm. longis, utroque latere circiter 0.5 mm. lata, angulis exterioribus dense ciliatis, pilis luteis circiter 1 mm. longis; spicula sessili straminea vel fulva, callo 1 mm. longo incluso circiter 5 mm. longa; glumis subaequalibus gluma prima anguste lanceolata, apice acuminata, bifida, carinata anguste alata, dorso plana, glabra, inferne levi, superne scaberula, praeter carinas 2–3-nervia; gluma secunda dorso inferne convexa, superne carinata, carina scaberrima, alioquin glabra levi, infra apicem minute bidentatum aristulam 1–2 mm. longam exserente; lemmate sterili 3-nervio, quam glumis paullo breviore, palea quam lemmate paullo breviore, antheris circiter 2 mm. longis; lemmate fertili quam lemmate sterili paullo breviore, in ½ superiore bifido, arista 15–20 mm. longa, columna fusca circiter 5 mm. longa; stigmatibus circiter 3 mm. longis, staminibus abortivis; spicula pedicellata lanceolata, glumis aequalibus vel subaequalibus, acuminatis, mucronatis vel aristatis, arista ad 1 mm. longa.

SOLOMON ISLANDS: San Cristoval: Waimamura, *Brass 2593* (GH, TYPE), August 5, 1932 (among coral rocks just above high water mark, common), *Brass 2813bis* (GH).

Ischaemum littorale is of the alliance of *I. foliosum,* from which it differs in having narrower blades, which are papillose-pilose above rather than glabrous, more slender rachis joints and pedicels, which bear shorter hairs on the outer angles, and in the much shorter awn on the second glume of the sessile spikelet. A further difference is seen in the pediceled spikelets, which have glumes bearing awns only up to 1 mm. long rather than 3–4 mm. long as in *I. foliosum.*

Comparison may also be made with *Ischaemum aureum* (Nees) Hack., but that species has glabrous nodes and sheaths, blades which are glabrous or only sparsely pilose at the base and on the margins, larger spikelets in which the second glume bears an awn about twice as long as that of *I. littorale,* and glumes of the pediceled spikelets long-ciliate on the keels.

6. **Ischaemum Turneri** Hack. in DC., Monogr. Phan. 6: 232. 1889; K. Schum., Notizbl. Bot. Gart. Berlin 1: 206. 1896. Type from New Ireland.

Sheaths glabrous, shorter than the internodes; ligule glabrous with a row of hairs in back of it; blades 10–15 cm. long, 12–18 mm. wide, more or less rigid, at first clothed with appressed hairs, becoming glabrous, the margins scabrous; racemes 3–4, 4–7 cm. long; rachis joints and pedicels about equal or the pedicel slightly longer, both trigonous, stout, ciliate on

the interior angles, somewhat bowed out at the base and slightly excavated within, leaving a small oblong opening between them; sessile spikelet 8–9 mm. long including the 1.8 mm. long glabrous callus; first glume purple-flecked on the back, narrowly winged on the upper half, the wings ciliolate-scabrous, the apex acuminate, entire; second glume equal to the first, rounded on the back and with a narrowly winged keel toward the apex; fertile lemma with a straight awn 5–6 mm. long; pediceled spikelet about 7 mm. long, similar to the sessile but the fertile lemma only mucronate, not awned.

NEW IRELAND: *Turner* (fragment of the TYPE specimen consisting of three rachis joints with three sessile and two pediceled spikelets attached) [20] (US).

New Britain, New Ireland, and New Caledonia.

No specimen was seen other than the small fragment cited. The description is a modification of the original by Hackel. Unfortunately Hackel was unable to give the height of the plant or any indication of its habit, since his description was based on a fragmentary specimen.

7. **Ischaemum digitatum** Brongn. in Duperry, Bot. Voy. Coquille 2: 70. *pl. 13.* 1831; Hack., Bot. Jahrb. 6: 238. 1885, in DC., Monogr. Phan. 6: 233. 1889. Type from the Moluccas.

Culms glabrous, ascending from a decumbent base, as much as 2 meters tall; the nodes sometimes sparsely bearded; sheaths keeled at least above, rather loose, glabrous or sparsely pilose; ligule membranous, 2–3 mm. long; blades linear-lanceolate, 15–30 cm. long, 6–15 (rarely to 20) mm. wide, glabrous, the margins scabrous; racemes 4–7 (rarely only 3), 5–8 cm. long; rachis joints and pedicels about equal, trigonous, the angles scabrous or short-ciliate, about 4 mm. long, bowed out equally at the base and slightly excavated within leaving a round or oblong opening between them; sessile spikelet 5–7 mm. long including the 1.5 mm. callus, 1.5 mm. wide, first glume smooth and shining below, the upper two-thirds striate, scabrous, the apex bidentate, the keels winged; second glume rounded on the back, narrowly wing-keeled toward the apex; sterile lemma as long as the glumes, acuminate; fertile lemma deeply cleft and bearing a geniculate twisted awn from the base of the cleft, the awn bent below the middle; pediceled spikelets similar but the fertile lemma entire or only slightly cleft, the awn short, not geniculate.

BRITISH NEW GUINEA: Central Division: Veiya, *Carr 11736* (NY) (river bank in the open); Western Division: Lake Daviumbu, Middle Fly River, *Brass 7528* (A, US) (savannahs; dominant grass of swamp margins); Daru Island, *Brass 6339* (A, US) (gregarious and dominant over a small wet-season swamp in savannah forest). NETHERLANDS NEW GUINEA: Bele River, 18 km. northeast of Lake Habbema, alt. 2200 m., *Brass 11385* (A, US) (covering the moister parts of old garden clearings); Balim River, alt. 1600 m., *Brass 11806* (A, US) (dominant grass on formerly cultivated river flats).

Malaysia to Polynesia.

7a. **Ischaemum digitatum** Brongn. var. **polystachyum** (Presl) Hack. in DC., Monogr. Phan. 6: 233. 1889.

Ischaemum polystachyum Presl, Rel. Haenk. 1: 328. 1830. Type from the Marianas.

Differing from the species in having prominently bearded nodes, the

[20] Fragment from the Berlin Herbarium, with no precise locality, collector's number, or date. The specimen was labeled "*Ischaemum Turneri*" in Hackel's hand.

sheaths densely pilose and the rachis joints and pedicels ciliate with long stiff hairs on the outer angles.

BRITISH NEW GUINEA: Central Division: Urunu, Vanapa Valley, alt. 1900 m., *Brass 4808* (US) (a few plants in small grassland swamps); Mafulu, alt. 1250 m., *Brass 5532* (GH, US) (common in regrowth brush on old garden lands); Gulf Division: Kerema, *Brass 1213* (GH, US) (open grassland near the coast); Northern Division: About 1 mile north of East Embi Lake, *Reeder 845* (A, US) (not common, low ground of grassland). NETHERLANDS NEW GUINEA: Bernhard Camp, Idenburg River, *Brass 13721* (A, US) (occasional in rain-forest seral growths on sandy flood banks). NEW BRITAIN: Talasea, near Waru village, alt. 200 m., *Burcham 140* (US) (sandy loam soil under coconut trees, abundant in this locality).

The Marianas to Malaysia and New Guinea.

Hitchcock (35, p. 126) reported *Brass 4808* and *5532* as *Ischaemum ciliare* Retz., but the second specimen is certainly *I. digitatum*. The identity of the other (*Brass 4808*) cannot be certain, since the plant is infected with a fungus and appears to be abnormal. The specimen is like *I. ciliare* in having only two racemes, but in that species both the pediceled and sessile spikelet have well developed geniculate awns. The Brass specimen has a well developed geniculate awn on the sessile spikelet, but the pediceled spikelet has only a short straight awn. Since the spikelets are those of *I. digitatum,* it seems best to refer the specimen to this species, especially since *I. ciliare* is not otherwise known from New Guinea.

8. **Ischaemum intermedium** Brongn. in Duperry, Bot. Voy. Coquille 73. 1831; Hack., Bot. Jahrb. 13: 261. 1891. Type from the Carolines.

Similar to *I. digitatum* in having 4–6 racemes, but a somewhat smaller species, in which the sessile spikelets have the apex of the first glume acuminate and entire rather than bifid. Both the sessile and pediceled spikelets have a well developed geniculate awn, although that of the sessile spikelet is often larger.

The Carolines to the Moluccas and New Guinea. Also in the Philippines.

Reported from New Guinea, but I have seen no specimen which could be distinguished from *I. digitatum*.

9. **Ischaemum fragile** R. Br., Prodr. Fl. Nov. Holl. 1: 205. 1810; C. E. Hubb., Hook. Ic. 33: *pl. 3263*. 1935; Hitchc., Brittonia 2: 127. 1936. Type from Australia.

Digastrium fragile (R. Br.) A. Camus, Bull. Soc. Bot. France 70: 850. 1923.

Perennial; culms glabrous, 40–110 cm. long, erect or ascending from a geniculate base, 3–7-noded, the nodes often bearded; sheaths keeled, glabrous to more or less pilose; ligule membranous, 2–3 mm. long, tapering to the obtuse, often ciliate apex; blades flat, linear, as much as 20 cm. long, 3–7 mm. wide, acuminate, the base long-attenuate, both surfaces glabrous to more or less densely pubescent, the margins usually scabrous; racemes solitary, 4–6 cm. long, long-exserted when mature; joints of the rachis and pedicels about equal, the pedicel slightly narrower, 3.5–4 mm. long, hemispheric-convex on the back, the inner cavity closed by a thin hyaline membrane, the margins and often the dorsal mid-line pilose; sessile spikelet 5–6 mm. long including the densely bearded callus; first glume emarginate, the upper part with two prominent wings, the lower half smooth and shining, the upper striate; second glume with a short

wing on the upper part of the keel, the apex with an awn 1–3 mm. long; sterile lemma hyaline, its palea firmer and enclosing a staminate flower; fertile lemma deeply cleft and bearing a twisted and geniculate awn from the base of the cleft, the awn 10–18 mm. long; pediceled spikelets reduced, smaller than the sessile, bearing a staminate flower or sometimes reduced to the glumes.

BRITISH NEW GUINEA: Western Division: Dagwa, Oriomo River, alt. 40 m., *Brass 5961* (US) (rare on damp soil on open ridges); Mabaduan, *Brass 6486* (A, US) (common in primary savannah-forest grass cover; most abundant in old garden lands); Lake Daviumbu, Middle Fly River, *Brass 7874* (A, US) (rare on savannahs of this locality), *Brass 7934* (A, US) (rare grass on wet savannahs).

Australia and New Guinea.

33. Apluda L.

Apluda L., Sp. Pl. 82. 1753, Gen. Pl. ed. 5. 35. 1754 (non Beauv. 1812).
Calamina Beauv., Ess. Agrost. 128. *pl. 23, fig. 1.* 1812.

Racemes solitary at the ends of the branches of a leafy open paniculate inflorescence, each partly enclosed in a swollen bract or spathe, reduced to one joint bearing three spikelets, one sessile and perfect, the others borne on flattened glume-like pedicels, one of the pediceled spikelets reduced to a minute flattened glume, the other staminate or neuter (rarely perfect) and as large as the sessile one; sessile spikelet with a thickened rounded callus, the first glume indurated, obtuse, rounded on the back, the margins somewhat inrolled; second glume membranous, gibbous below, the keel depressed above; lower floret staminate, the lemma hyaline, about as long as the glumes, the palea nearly as long, 2-nerved; upper floret perfect, the lemma gibbous on the back, 1-nerved, awnless or short-awned, the palea about half as long; pediceled spikelet similar but both glumes somewhat indurate and the tip of the second glume not depressed. A straggling much branched perennial.

TYPE AND ONLY SPECIES: *Apluda mutica* L.

1. **Apluda mutica** L., Sp. Pl. 82. 1753; F. Muell., Pap. Pl. 1: 46. 1876. Type from India.
Apluda varia Hack. subsp. *mutica* Hack. in DC., Monogr. Phan. 6: 197. 1889.

Culms glabrous, 1–2 meters long, wiry, weak and straggling, decumbent at base, geniculately ascending, usually leaning on other vegetation; sheaths glabrous, usually shorter than the internodes; ligule membranous, 1–2 mm. long; blades scabrous, linear, 10–40 cm. long, 3–10 (rarely to 15) mm. wide, acuminate, the apex often setaceous, the base gradually narrowed into a short petiole; inflorescence narrow, often zig-zag, the axis very slender; spikelets 3–4 mm. long, these and the cymbiform spathes often pruinose.

BRITISH NEW GUINEA: Central Division: Hula, *Brass 522* (GH, US) (damp hollows in coast sandhills); Roana, Laloki River, alt. 450 m., *Brass 3613* (A, US) (rocky savannahs, not plentiful); Mafulu, alt. 1250 m., *Brass 5403* (GH, US) (common, straggling amongst tall *Imperata* on artificial grass slopes); Veiya, *Carr 11741* (NY) (open country); Port Moresby, *MacFarlane 48* (US), *C. T. White 30* (US); Northern Division: Ambasi, *King 1018* (US); about 9 miles northwest of Oro Bay, *Reeder 819* (A, US) (common in grassland); Western Division: Dagwa, Oriomo River, alt. 40 m., *Brass 5957* (GH, US) (growing amongst coarse grasses on an old garden site on open savannah); Daru Island, *Brass*

6431 (A, US) (rare in savannah forests); Lake Daviumbu, Middle Fly River, *Brass 7771* (A, US) (few plants in old village clearing); Goodenough Island: Haiwali, alt. 30 m., *Burcham 119* (US) (two miles inland on coastal plain, grassy clearing in rain forest). NORTHEAST NEW GUINEA: Morobe District: Finschhafen, *Warburg 20968* (A), *Weinland 290* (US); near Kajabit Mission, alt. about 500 m., *Clemens 10631* (US). NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11798* (A, US) (plentiful subsidiary grass on deforested slopes).

India to China, Formosa, the Philippines, Malaysia, New Guinea, and New Caledonia.

34. Hackelochloa Kuntze

Hackelochloa Kuntze, Rev. Gen. 2: 776. 1891.

Manisuris L. f., Nov. Gram. Gen. 37. 1779 (non L., Mant. 2: 164. 1771).

Rytilix Raf., Bull. Bot. Seringe 1: 219. 1830.[20a]

Spikelets in pairs, dimorphic, awnless, one sessile and perfect, the other pediceled, staminate or neuter; rachis fragile, readily disarticulating, the joints and pedicels firmly grown together, the two clasped between the edges of the coriaceous, subhemispheric, foveolate first glume of the sessile spikelet; second glume chartaceous and set in a cavity in the slightly hollowed out fused rachis joint and pedicel and more or less adnate to it; lemmas hyaline, the lower empty, the upper perfect; pediceled spikelets conspicuous, ovate, the glumes membranous, green. Annuals with freely branching culms, flat blades, and numerous solitary spikelike racemes borne on the ends of slender fascicled spatheate branches.

TYPE SPECIES: *Hackelochloa granularis* (L.) Kuntze (*Cenchrus granularis* L.).

1. **Hackelochloa granularis** (L.) Kuntze, Rev. Gen. 2: 776. 1891; Hitchc., U. S. Dept. Agric. Misc. Publ. 200: 764. *fig. 1689*. 1935, Brittonia 2: 127. 1936.

Cenchrus granularis L., Mant. 2: 575. 1771. Type from India.

Manisuris granularis (L.) L.f., Nov. Gram. Gen. 40. *pl. 1, fig. 4–7*. 1779; Swartz, Prodr. Veg. Ind. Occ. 25. 1788; Beauv., Ess. Agrost. *pl. 21, fig. 10*. 1812; K. Schum., Notizbl. Bot. Gart. Berlin 2: 90. 1898.

Culms more or less decumbent, 20–100 cm. tall, glabrous or sparsely hispid; sheaths rather loose, keeled, papillose-hispid; blades lanceolate-linear, flat, papillose-hispid like the sheaths, 5–15 cm. long, the base more or less cordate; racemes 1–2.5 cm. long, borne on slender peduncles, shortly exserted or the base included in the spathe; sessile spikelets 1–1.5 mm. long, equaling or a little longer than the rachis joints, the pediceled spikelets 1.5–2 mm. long.

BRITISH NEW GUINEA: Central Division: Baroka, Nakeo District, alt. 50 m., *Brass 3701* (A, US) (common in shelter of taller savannah forest); Northern Division: About 8 miles northwest of Oro Bay, *Reeder 806* (A, US) (sandy soil along old jeep road; apparently not common). NORTHEAST NEW GUINEA: Morobe District: *Clemens 4307* (A); near Kajabit Mission, alt. 250–600 m., *Clemens 40782* (US); Wantoat, alt. about 1000 m., *Clemens 40867* (US).

Tropics of both hemispheres.

35. Hemarthria R. Br.

Hemarthria R. Br., Prodr. Fl. Nov. Holl. 1: 207. 1810.

Spikelets paired, 1-flowered, one sessile, the other pediceled, both alike

[20a] Not effectively published. For details see Hitchcock, Contr. U. S. Nat. Herb. 24: 506. 1927, and U. S. Dept. Agric. Bull. 772 (revised): 286. 1936.

or the pediceled spikelets narrower and attenuate, the pedicels appressed to the rachis, usually adnate to it and forming with the hollowed-out rachis joint a cavity containing the sessile spikelet; rachis disarticulating tardily or not at all; first glume coriaceous, dorsally flattened, fitting over the hollow containing the spikelet; second glume cymbiform, membranous-hyaline, more or less adnate to the rachis joint; lemmas hyaline, the lower empty, the upper (fertile) awnless, usually with a small palea; pediceled spikelet acuminate or attenuate, both glumes coriaceous, the second usually longer than the first, free, the apex attenuate or awn-pointed. Perennials with mostly decumbent culms and terminal spikelike racemes solitary on the culms and branches.

TYPE SPECIES: *Hemarthria compressa* (L. f.) R. Br. (*Rottboellia compressa* L. f.).

1. **Hemarthria subulata** sp. nov. PLATE V, *Figs. c-e.*

Probabiliter perennis; culmis compressis glabris erectis, ramosis, 1–1.5 m. altis; nodis 4–6; vaginis glabris plus minusve laxis, supra quam internodiis brevioribus, eis infra medium culmi plerumque quam internodiis longioribus; ligula ciliata, circiter 1 mm. longa; laminis linearibus, laxis, ad 60 cm. longis, 2–4 mm. latis, utrinsecus glabris, marginibus scabris; racemis solitariis, gracilibus, 10–20 cm. longis, rhachi tenaci sed denique plus minusve disjuncta, articula infra spiculam longe acuminato-cuspidata; spicula sessili hermaphrodita, articula aequali vel paullo breviore; gluma prima indurata, acuta, 7-nervia; gluma secunda articula plus minusve adnata, membranaceo-scariosa; lemmatibus subaequalibus; lemmate sterili quam glumis circiter quarte parte breviore, palea sterili nulla; lemmate fertili quam lemmate sterili saepe paullo breviore, palea fertili quam lemmate quarta vel tertia parte breviore; staminibus 3, antheris circiter 4 mm. longis; spicula pedicellata acuminata, quam spicula sessili angustiore, ceterum simili, pedicellis articulis saepius laxiuscule adnatis rarius liberis, spicula sessili circiter aequali; glumis induratis, prima dorso complanata, secunda cymbiformi, carinata, carina anguste alata, ceterum spicula sessili simili.

BRITISH NEW GUINEA: Western Division: Lake Daviumbu, Middle Fly River, *Brass 7552* (A, US, TYPE) August, 1936 (in savannahs, common on margins of swamps); Dagwa, Oriomo River, *Brass 6001* (GH, US) (rare grass on a small marshy flat).

Apparently closely related to *Hemarthria protensa* Nees ex Steud., but differing in having stiffly erect rather than decumbent culms, much longer and narrower blades with scabrous margins, a disarticulating rachis, the first glume 7-nerved, and the fertile lemma well developed rather than obsolete or only about one-fourth the length of the spikelet. *Brass 6001* was reported as *Manisuris protensa* (Nees ex Steud.) Hitchc. (*H. protensa* Nees ex Steud.) by Hitchcock (35, p. 127).

36. **Eremochloa** Buse

Eremochloa Buse in Miquel, Pl. Jungh. 1: 357. 1854.
Pectinaria Hack., Nat. Pflanzenfam. II. 2: 26. 1887.

Spikelets appearing solitary at each node, but actually paired, only the sessile developing, the pediceled reduced to a glume-like or stipiform

pedicel; sessile spikelets dorsally compressed, awnless, imbricate along one side of a tardily disarticulating rachis; glumes chartaceous, the first broad, flat or only slightly rounded on the back, the margins narrowly inflexed, 2-keeled, the keels spinulose or rigidly pectinate, at least on the lower part; second glume 3-nerved, the midnerve sometimes keeled; lemmas hyaline, the lower 3-nerved, triandrous, the palea similar; fertile lemma entire, usually nerveless, the palea similar but narrower. Slender perennials with solitary terminal racemes.

TYPE SPECIES: *Eremochloa Horneri* Buse = *E. ciliaris* (L.) Merr. (*Nardus ciliaris* L.).

KEY TO THE SPECIES

1. First glume wingless at summit, the marginal setae longer than the width of the glume.....1. *E. ciliaris.*
1. First glume with short narrow wings just below the summit, the marginal setae usually shorter than the width of the glume.....2. *E. bimaculata.*

1. **Eremochloa ciliaris** (L.) Merr., Philip. Jour. Sci. 1: Suppl. 331. 1906; Ohwi, Bot. Mag. (Tokyo) 56: 11. 1942.
Nardus ciliaris L., Sp. Pl. 53. 1753. Type from India.
India to China, the Philippines, and (?) New Guinea.

1a. **Eremochloa ciliaris** (L.) Merr. var. **elata** var. nov.

A typo culmis multo altioribus, laminis longioribus et rigidioribus arcte conduplicatis differt.

Culms erect, strongly flattened, 4–5-noded, glabrous to more or less pubescent, 75–110 cm. tall, branching from the middle and upper nodes; sheaths glabrous, shorter than the internodes, strongly keeled; ligule membranous, truncate, 0.5–1 mm. long; blades erect, firm, closely folded, as much as 25 cm. long, 3–6 mm. wide opened out; racemes 3–5 cm. long, straight or falcate; rachis joints clavate, about 2 mm. long, with a ring of short cilia at the base, otherwise glabrous; spikelets ovate, 4–5 mm. long; first glume glabrous or minutely pubescent, keels not winged, the setae more or less scabrous, longer than the width of the spikelet; sterile pedicel narrow, one-third to half as long as the spikelet.

BRITISH NEW GUINEA: Western Division: Lake Daviumbu, Middle Fly River, *Brass 7808* (A, TYPE, US) Sept., 1936 (probably a rare glaucous form of the common *7849*), *Brass 7849* (A, US) (common on hummocks on wet grass plains).

Differs from the species in being much taller and having longer and firmer, closely folded blades.

2. **Eremochloa bimaculata** Hack. in DC., Monogr. Phan. 6: 265. 1889; Chase, Jour. Arnold Arb. 20: 314. 1939. Type from India.

Culms simple, slender, strongly flattened, tufted, 40–60 cm. tall, glabrous or sparsely pubescent; sheaths shorter than the internodes, rather densely papillose-pilose, the upper bearing reduced blades; ligule membranous, about 0.3 mm. long; blades 8–13 cm. long, 2–3 mm. wide, flat, flaccid, glabrous or more or less densely papillose-pilose; racemes 3.5–5 cm. long, the rachis undulate, the joints clavate, about half as long as the spikelets; spikelets ovate, 4–5 mm. long, the first glume glabrous or minutely pubescent on the back, the keels with short narrow brownish wings just below the apex, the setae widely spreading, mostly shorter than the width of

the glume; sterile pedicel about one-third shorter than the spikelet, abruptly acuminate, broadest in the middle.

BRITISH NEW GUINEA: Western Division: Wuroi, Oriomo River, *Brass 5743* (A, US) (common on grey soil of savannah ridges); Tarara, Wassi Kussa River, *Brass 8408* (A, US) (common in savannah forests).

India to Australia and New Guinea.

The cited specimens differ from Hackel's original description in having the nodes glabrous or only slightly pubescent and the blades more or less densely papillose-pilose rather than glabrous. In other respects they agree well with both the description and a fragment of the type specimen (at US). The short narrow wings just below the tip of the first glume are distinctive. *Brass 5743* was reported by Hitchcock (35, p. 127) as *Eremochloa ciliaris*, a closely related species having culms often branching from the upper and middle nodes and the first glume not winged.

37. **Elyonurus** Humb. & Bonpl. ex Willd.

Elyonurus Humb. & Bonpl. ex Willd., Sp. Pl. 4: 941. 1806.

Spikelets strongly dorsally flattened, awnless, in pairs, one sessile and perfect, the other pediceled, similar to the sessile or (in ours) much reduced, the pair falling attached to the rachis joint; rachis usually somewhat tardily disarticulating, breaking obliquely and forming a sharp-pointed callus; rachis joints and pedicels somewhat thickened, parallel, the rachis joint concave within and with the sessile spikelet appressed to it; first glume chartaceous to weakly coriaceous, dorsally flattened and with a line of balsam glands just inside the keels, the margins inflexed around the second glume, acute or acuminate, entire or bifid with aristate teeth; second glume chartaceous, weakly keeled on the back, the apex acuminate; lemmas hyaline, the palea much reduced or wanting. Erect moderately tall perennials with solitary, spikelike, often woolly racemes.

TYPE SPECIES: *Elyonurus tripsacoides* Humb. & Bonpl.

1. **Elyonurus citreus** (R. Br.) Munro ex Benth., Fl. Austral. 7: 510. 1878; White, Proc. Roy. Soc. Queensl. 34: 15. 1923; Hitchc., Proc. Linn. Soc. N. S. Wales 54: 145. 1929.

   Andropogon citreus R. Br., Prodr. Fl. Nov. Holl. 1: 203. 1810. Type from Australia.

   ? *Elyonurus papuanus* Lauterb. & K. Schum. in K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 171. 1901. Type from Northeast New Guinea.

Culms tufted, glabrous, slender, 50–100 cm. tall, with floriferous branches from the upper one or two nodes; sheaths shorter than the internodes, glabrous to very sparsely pubescent, often more or less pilose in the throat; ligule ciliate, about 1 mm. long; blades 10–20 cm. long, involute, subfiliform, rigid, glabrous; racemes solitary on the culms and branches, 5–8 cm. long, silky-woolly from the spreading hairs on the rachis and pedicels; rachis joints 5–6 mm. long, the white hairs on the upper part 3–4 mm. long; pedicel about equal and with similar hairs; sessile spikelet 10–13 mm. long including the 2–3 mm. long, bearded callus; first glume very slightly convex on the back, glabrous or more or less pilose, the acuminate apex about as long as the body and split into two long flattened aristate teeth, the margins of the glume and the teeth pectinate with stiff hairs

as much as 1 mm. long; second glume about half as long as the first, keeled on the back, acuminate; pediceled spikelets shorter and narrower than the sessile, reduced to a pair of aristate empty glumes, the second about one-fourth shorter than the first, one margin of the first glume prominently pectinate, the other short-pectinate or merely scabrous.

BRITISH NEW GUINEA: Eastern Division: Kurandi, *Brass 1397* (GH, US) (on old garden clearings); Western Division: Lake Daviumbu, Middle Fly River, *Brass 7920* (A, US) (gregarious in small clumps on hard pebbly soil in savannahs).

Australia and New Guinea.

The type of *Elyonurus papuanus* has not been seen, but from the description it appears to be a synonym of *E. citreus*.

38. Rottboellia L.f.

Rottboellia L. f., Nov. Gram. Gen. 22. *pl. 1.* 1779 (non Scop. 1777). Nom. conserv.
Stegosia Lour., Fl. Cochinch. 51. 1790.

Spikelets paired, awnless, one sessile and perfect, usually sunken in the cavities of the thickened articulate rachis, the other pediceled and staminate or sometimes rudimentary, the pedicels free or closely appressed to the rachis joints; joints of the rachis with a projection on the lower end fitting into a corresponding cavity in the upper end of the next lower joint; glumes coriaceous or chartaceo-membranous, the first dorsally convex or flattened, the second cymbiform, sometimes gibbous on the back; lemmas hyaline or thinly membranous, the lower staminate or neuter, the fertile 1–3-nerved and with a subequal palea. Annuals or perennials with usually stout readily disarticulating spikelike racemes solitary or fascicled in the axils of spatheate sheaths.

TYPE SPECIES: *Rottboellia exaltata* L. f.

KEY TO THE SPECIES

1. Pedicels flattened, very unlike the hollowed out rachis joint; sessile spikelets about 5 mm. long ..... 1. *R. exaltata.*
1. Pedicels similar to the rachis joints but slightly shorter, both subclavate; sessile spikelets 3–4 mm. long ..... 2. *R. rottboellioides.*

1. **Rottboellia exaltata** L. f., Nov. Gram. Gen. 22. *pl. 1.* 1779, Suppl. Pl. 114. 1781; Chase, Jour. Arnold Arb. 20: 314. 1939; C. E. Hubb. & Vaughan, Grass. Maurit. & Rodriguez 117. *fig. 16.* 1940. Type from India.
Manisuris exaltata (L. f.) Kuntze, Rev. Gen. 2: 779. 1891.
Stegosia exaltata (L. f.) Nash, N. Am. Fl. 17: 84. 1909.

Annual; culms erect, stout, branching, 60–200 cm. tall, glabrous or hispid below, often glaucous below the raceme; sheaths rather loose, usually densely papillose-hispid; ligule membranous, short-ciliate, about 1.5 mm. long; blades flat, linear-lanceolate, 15–50 cm. long, 5–25 mm. wide, often glaucous beneath, the margins serrulate-scabrous; racemes 8–15 cm. long, stout below and attenuate with imperfect spikelets above, scaberulous, often pale yellow except for the greenish first glume of the pediceled spikelets; joints of the rachis slightly longer than the sessile spikelets, hollowed out and the spikelet borne in the hollows; first glume about 5 mm. long, strongly indurated, emarginate, the second strongly gibbous

on the back; pediceled spikelet 3–4.5 mm. long, the pedicel somewhat flattened, about half as long as the rachis joint and closely appressed to it; first glume striate, green, obtuse or emarginate.

BRITISH NEW GUINEA: Western Division: Daru Island, *Brass 6296* (A, US) (plentiful and forming dense brakes on wet garden land behind mangroves).

Tropics of both hemispheres.

2. **Rottboellia rottboellioides** (R. Br.) comb. nov.

Ischaemum rottboellioides R. Br., Prodr. Fl. Nov. Holl. 1: 205. 1810. Type from Australia.

Andropogon rottboellioides (R. Br.) Steud., Syn. Pl. Glum. 1: 382. 1854.

Rottboellia ophiuroides Benth., Fl. Austral. 7: 514. 1878; K. Schum. & Hollr., Fl. Kais. Wilhelmsland 22. 1889. Based on *Ischaemum rottboellioides* R. Br.

Manisuris rottboellioides (R. Br.) Kuntze, Rev. Gen. 2: 779. 1891; Hitchc., Brittonia 2: 127. 1936.

Coelorachis rottboellioides (R. Br.) A. Camus, Ann. Soc. Linn. Lyon 68: 197. 1921.

Perennial; culms glabrous, subrobust, 1–2 meters tall; sheaths rather firm, glabrous or rarely somewhat short-pubescent, usually pubescent on the collar; ligule membranous, ciliate, 1–2 mm. long; blades 25–50 cm. long, 8–20 mm. wide, both surfaces glabrous (rarely more or less short pubescent), the margins serrulate-scabrous; racemes 6–8 cm. long, terminal on slender fascicled spatheate branches; joints of the rachis about one-fourth shorter than the sessile spikelets, subclavate, slightly keeled on the back, the inside somewhat concave; pedicels similar but slightly shorter, free from the rachis joint; sessile spikelet 3–4 mm. long; glumes coriaceous, glabrous, the first ovate-oblong, emarginate, the keels narrowly winged, often unequally so; second glume cymbiform, keeled on the back, the keel narrowly winged toward the apex; pediceled spikelets similar to the sessile, usually smaller, rarely as large or reduced to a pair of narrow glumes.

BRITISH NEW GUINEA: Central Division: Budotobara, *Brass 776* (GH, US) (large savannah grass); Baroka, Nakeo District, alt. 50 m., *Brass 3702* (GH, US) (scattered amongst the dominant *Anthistiria* [*Themeda*] on savannah forest ridges); Mafulu, alt. 1250 m., *Brass 5310* (GH, US) (on artificial grasslands); Gosaro, Rigo District, *MacGregor 19* (US); Western Division: Daru Island, *Brass 6254* (A, US) (abundant in savannah forest and in some moist shaded situations the dominant grass); Gaima, Lower Fly River, *Brass 8254* (A, US) (dominant grass on savannah forests); Northern Division: About 9 miles northwest of Oro Bay, *Reeder* 809 (A)[21] (conspicuous constituent of the grassland); Goodenough Island: Haiwali village, *Burcham 124* (US) (grassy clearing in rain-forest, appears to grow mainly in full sun). NORTHEAST NEW GUINEA: Morobe District: Four miles south of Langemak Bay, near Finschhafen, *Sawyer 51* (A).

Australia and New Guinea.

39. **Thaumastochloa** C. E. Hubb.

Thaumastochloa C. E. Hubb., Hook. Ic. 34: *pl. 3313, 3314.* 1936.

Spikelets awnless, solitary at each node, all facing in the same direction; pediceled spikelets wanting or reduced to a minute glume, the pedicel firmly adnate to the rachis joint and forming with it a semicylindrical internode

[21] This collection consists of a mixture, the specimen at the U. S. National Herbarium being *Ophiurus exaltatus*.

hollowed out within and with the first glume fitting tightly over the hollow containing the spikelet; racemes subcylindric-flattened, terminal, single or fascicled, consisting of 1 or 2 or a greater number of spikelets, these asymmetrical with the tips pointing in opposite directions, the peduncle gradually thickened upward and merging into the lowest rachis joint; first glume coriaceous, smooth or rugose on the back, the margins often inrolled; second glume cymbiform, membranous, 3–5-nerved; lemmas hyaline, the lower epaleate and empty; fertile lemma with a similar narrow palea and a perfect flower. Annuals or perennials with usually short slender somewhat flattened spikelike racemes and slender branching culms.

TYPE SPECIES: *Thaumastochloa pubescens* (Domin) C. E. Hubb. (*Ophiuros pubescens* Domin).

1. **Thaumastochloa rariflora** (F. M. Bailey) C. E. Hubb., Hook. Ic. 34: *pl. 3313.* 1936; Chase, Jour. Arnold Arb. 20: 314. 1939.

Rottboellia rariflora F. M. Bailey, Queensl. Dept. Agric. Bot. Bull. 8: 86. 1893. Type from Australia.

Annual; culms slender, geniculately ascending to erect, 10–60 cm. tall, the nodes pubescent to glabrous; sheaths much shorter than the internodes, keeled above, more or less densely pilose, the hairs often papillose-based; ligule membranous, ciliate, about 0.2 mm. long; blades flat or involute in drying, 2–10 cm. long, 2–4 mm. wide; racemes dorsally compressed, bearing one or two spikelets, solitary or fascicled and more or less included in the sheaths; peduncle 0.5–2.5 cm. long, the lower part tapering to a very slender base, becoming curved and readily disarticulating; rachis fragile, disarticulating horizontally, the 1 or 2 rachis joints smooth, glabrous, 2.5–3 mm. long, the upper terminating in a blunt apex scarcely exceeding the spikelet or in an acumen 1–6 mm. long; first glume dorsally flattened to slightly concave, granular-punctate, 9-nerved within, the margins minutely pubescent at the base; second glume 3–5-nerved, the upper margins very minutely ciliolate; remainder of the spikelet as in the generic description.

BRITISH NEW GUINEA: Western Division: Wuroi, Oriomo River, alt. 30 m., *Brass 6014* (GH, US) (uncommon on grey soil on savannah ridge); Mabaduan, *Brass 6554* (A, US) (occasional under the dominant *Themeda triandra* in savannah forests).

Australia and New Guinea.

The cited specimens differ from Hubbard's description and illustration, and from the one Australian specimen seen, in having the apex of the upper rachis joint terminating in a blunt point rather than in an acumen 1–6 mm. long. In other respects they seem identical. *Brass 6014* was cited as *Ophiuros pubescens* Domin [*Thaumastochloa pubescens* (Domin) C. E. Hubb.] by Hitchcock (35, p. 128), but in that species the raceme is composed of 4–9 spikelets in which the first glume is dorsally foveolate-tuberculate to transversely rugose.

40. **Ophiuros** Gaertn. f.

Ophiuros Gaertn. f., Suppl. Carpol. (Fruct. & Sem. 3) 3. *pl. 181, fig. 3.* 1805, pro parte.

Spikelets awnless, solitary at each node, distichous, the pediceled spike-

lets wanting, the pedicel firmly adnate to the rachis joint and forming with it a thick semi-cylindrical internode deeply hollowed out within, the first glume fitting tightly over the hollow containing the spikelet; first glume coriaceous, convex on the back and with a small groove at the base just above the narrow circular callus; second glume cymbiform, chartaceous; lemmas hyaline, as long as the spikelet, the first with a well developed palea and usually a staminate flower; fertile lemma with a similar palea and a perfect flower. Tall, coarse perennials with flat blades and smooth slender, spikelike, solitary racemes.

TYPE SPECIES: *Ophiuros corymbosus* (L. f.) Gaertn. f. = *O. exaltatus* (L.) Kuntze (*Aegilops exaltata* L.).

1. **Ophiuros exaltatus** (L.) Kuntze, Rev. Gen. 2: 780. 1891; Hitchc., Brittonia 2: 127. 1936.

Aegilops exaltata L., Mant. app. 575. 1771. Type from India.

Rottboellia corymbosa L. f., Suppl. Pl. 114. 1781. Type from India.

Ophiuros corymbosus (L. f.) Gaertn. f., Suppl. Carpol. (Fruct. & Sem. 3) 3–4. *pl. 181, fig. 3B.* 1805; Blatter & McCann, Imp. Council Agric. Res. Sci. Monogr. 5: 40. *pl. 28.* 1935.

Culms glabrous, subrobust, erect from more or less bulbous bases, 1–2 meters tall, with floriferous branches from the upper 2 or 3 nodes; lower sheaths glabrous, the upper often pilose on the margins and more or less dorsally papillose-hispid; blades linear to linear-lanceolate, as much as 60 cm. long, 8–25 mm. wide, rounded or subcordate at base, the margins often papillose-hispid; racemes 6–15 cm. long, about 1.5 mm. in diameter, solitary on slender fascicled branches, these more or less included in the sheaths of the upper leaves; rachis fragile, the joints about 3 mm. long, both ends obliquely truncate, the upper concave, the lower with a small projection which fits into the top of the joint below; first glume ovate-oblong, the dorsal surface smooth or more or less foveolate with 2–4 rows of small depressions, the remainder of the spikelet as in the generic description.

BRITISH NEW GUINEA: Central Division: Rona, Laloki River, alt. 450 m., *Brass 3586* (GH, US) (fairly common in *Eucalyptus* savannahs); Baroka, Nakeo District, alt. 50 m., *Brass 3724* (GH, US) (common in *Eucalyptus* savannah ridges); Kanosia, alt. about 30 m., *Carr 11134* (NY) (open savannah land); Western Division: Wuroi, Oriomo River, alt. 10–30 m., *Brass 5735* (GH, US) (scattered on savannah ridges); Mabaduan, *Brass 6537* (A, US) (fairly common in grass cover of savannah forests); Lake Daviumbu, Middle Fly River, *Brass 7643* (A, US) (open savannah); Northern Division: About 9 miles northwest of Oro Bay, *Reeder 809* (US)[22] (common constituent of the grassland). NORTHEAST NEW GUINEA: Morobe District: Markham Valley, Kajabit, *Clemens 40838* (US); Finschhafen, *Weinland 266* (US).

41. Sorghum Moench

Sorghum Moench, Meth. Pl. 207. 1794.

Holcus L., Sp. Pl. 1047. 1753, pro parte.

Spikelets in pairs or in threes at the ends of the branches, one sessile and fertile, the other pediceled, staminate or neuter, sometimes reduced to a single narrow glume; sessile spikelet dorsally compressed; glumes

[22] This collection consists of a mixture, the specimen at the Arnold Arboretum being *Rottboellia rottboellioides*.

firmly coriaceous, the first rounded on the back or flattened, the margins involute, not keeled; second glume somewhat cymbiform but rounded on the back, not or only slightly keeled; lemmas hyaline or thinly membranous, the lower empty, the upper (fertile) oblong, bifid and awned from the sinus, or entire and awnless. Annuals or perennials with terminal panicles of numerous 1–5-jointed racemes.

TYPE SPECIES: *Sorghum saccharatum* (L.) Moench (*Holcus saccharatus* L. pro parte) = *Sorghum dochna* (Forsk.) Snowden.

KEY TO THE SPECIES

1. Panicle branches in whorls; pediceled spikelet staminate; hairs of the inflorescence brown.....1. *S. nitidum*.
1. Panicle branches solitary or in twos or threes; pediceled spikelet reduced to a narrow glume; hairs of the inflorescence white.....2. *S. laxiflorum*.

1. **Sorghum nitidum** (Vahl) Pers., Syn. Pl. 1: 101. 1805; Hitchc., Brittonia 2: 129. 1936.

Andropogon serratus Thunb., Fl. Jap. 41. 1784. Type from Japan.
Holcus nitidus Vahl, Symb. Bot. 2: 102. 1791. Type from India.
Holcus fulvus R. Br., Prodr. Fl. Nov. Holl. 1: 199. 1810. Type from Australia.
Sorghum fulvum (R. Br.) Beauv., Ess. Agrost. 164. 1812; White, Proc. Roy. Soc. Queensl. 34: 15. 1923.
Andropogon tropicus Spreng., Syst. Veg. 1: 287. 1825; Kunth, Rev. Gram. 1: *pl.* 97. 1829. Based on *Holcus fulvus* R. Br.
Sorghum tropicum (Spreng.) Buse in Miquel, Pl. Jungh. 359. 1854.
Sorghum serratum (Thunb.) Kuntze, Rev. Gen. 2: 792. 1891 (non Roem. & Schult. 1817).

Perennial; culms erect or ascending, 60–100 cm. tall, often decumbent, rooting and branching from the lower nodes; nodes densely bearded; sheaths mostly shorter than the internodes, glabrous or sometimes pubescent; ligule membranous, 1.5–2.5 mm. long, ciliolate; blades flat, linear, as much as 50 cm. long, 4–11 mm. wide, glabrous and smooth except for the scabrous margins; panicle oblong, 10–30 cm. long, the slender branches verticillate, naked below, simple and bearing a single terminal raceme (rarely the lower branches once or twice branched); racemes 1–2 cm. long, the rachis joints and pedicels ciliate with brown hairs, the pedicel shorter than the sessile spikelet, the rachis joint from equal to more than twice as long; sessile spikelet ovate to ovate-lanceolate, 3–4 mm. long, brownish or finally shining black, pubescent with brown hairs, awnless or with a twisted and geniculate awn 10–15 mm. long; pediceled spikelets staminate, of about the same size as the sessile, but the glumes membranous or chartaceous and lighter in color.

BRITISH NEW GUINEA: Central Division: Kanosia, *Carr 11111* (US) (open savannah land); *Carr 11135* (NY) (open savannah land); Roana, Laloki River, alt. 450 m., *Brass 3629* (GH, US) (common species growing sporadically all through the savannahs); Western Division: Wuroi, Oriomo River, *Brass 5895* (GH, US) (among *Imperata cylindrica* in savannah forest); Daru Island, *Brass 6252* (A, US) (abundant in tall grass ground cover of savannah forest); Lake Daviumbu, Middle Fly River, *Brass 7644* (A, US) (occasional in savannahs); Gaima, Lower Fly River, *Brass 8263* (A, US) (common in savannah forest grass cover); Tarara, Wassi Kussa River, *Brass 8567* (A, US) (savannah forest; associated with *Imperata* on well drained soils); Northern Division: About 9 miles northwest of Oro Bay, *Reeder 808* (A, US) (common on grassland); Goodenough

Island: Haiwali village, *Burcham 121* (US) (grassy clearing in rain-forest). NORTHEAST NEW GUINEA: Morobe District: Kajabit Mission, *Clemens 10665* (US); Finschhafen, *Weinland 281* (US). NETHERLANDS NEW GUINEA: West of Hollandia, *Sigafoos 68* (A); Balim River, alt. 1600 m., *Brass 11618* (A, US) (one of principal grasses on sandy deforested slopes). NEW BRITAIN: *Parkinson 45* (US).

India to Japan, Malaysia, and Australia.

All the cited specimens except *Brass 11618* and *Parkinson 45* are awnless. In the former, only part of the spikelets of the panicle are awned.

2. **Sorghum laxiflorum** F. M. Bailey, Rep. Exped. Bellenden. 70. 1889, Syn. Queensl. Fl. Suppl. 3: 84. 1890, Comp. Cat. Queensl. Pl. 620. *fig. 595*. 1909. Type from Australia.

Andropogon Baileyi F. Muell., Vict. Nat. 8: 16. 1891. Based on *Sorghum laxiflorum* F. M. Bailey.

Andropogon Sorghum (L.) Brot. subsp. *halepensis* (L.) Hack. var. *albovillosa* Lauterb. & K. Schum. in K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 173. 1901. Type from Northeast New Guinea.

Annual; culms weak, freely branching, decumbent below and rooting from the lower nodes, ascending to 1.5 meters, pubescent below the panicle, otherwise glabrous except for the short bearded nodes; sheaths mostly shorter than the internodes, more or less ciliate on the margins, otherwise glabrous; ligule membranous, about 1 mm. long, minutely ciliolate; blades linear, rather firm, flat or folded, the margins sometimes revolute, as much as 70 cm. long, 4–10 mm. wide, the apex long-attenuate, glabrous below, the upper surface and margins scabrous to hispid; panicle 15–20 cm. long, the slender lax branches solitary or in twos or threes at the nodes of the axis, bearing 2 to several capillary branchlets each with 1–3 pairs of spikelets toward their tips; rachis joints and pedicels slender, about equal, shorter than the sessile spikelets, white-ciliate on the margins; sessile spikelets about 5 mm. long, narrowly oblong, toward the apex abruptly narrowed into a neck about 1 mm. long; glumes coriaceous, dark brown when mature, the callus and dorsal surface pilose with white hairs; second glume glabrous or only slightly pilose; awn of the fertile lemma 3–4 cm. long, geniculate below the middle, the column dark brown, shining, the margins short-stiff-pubescent with white hairs; pediceled spikelets reduced to one membranous, narrow to subulate glume about 3 mm. long.

BRITISH NEW GUINEA: Northern Division: About 3 miles south of Dobodura, *Reeder 822* (US) (growing on edge of jungle). NORTHEAST NEW GUINEA: Morobe District: Salamaua, *Clemens 34* (A) (trail bank, hill near beach); Malshang, near Lae, *Clemens 10441* (US); Wantoat, *Clemens 10980, 41090* (US).

Australia to New Guinea and the Philippines.

42. Chrysopogon Trin.

Chrysopogon Trin., Fund. Agrost. 187. 1820. Nom. conserv.

Rhaphis Lour., Fl. Cochinch. 2: 552. 1790.

Pollinia Spreng., Pl. Pugill. 2: 10. 1815 (non Trin. 1832).

Spikelets mostly in threes at the ends of the panicle branches and branchlets, one sessile and perfect, two pediceled and staminate or neuter, the group falling together, rarely the spikelets in pairs on a 2–4-jointed rachis, but then the spikelets in threes at the ends of the branches; sessile spikelets disarticulating obliquely and forming a more or less elongate sharp-

pointed callus, the callus usually bearded at least on the margins; first glume involute, rounded on the back, keeled upward, the keels usually spiny-hispid; second glume cymbiform, keeled toward the apex and usually aristate; lemmas hyaline, the first 2-nerved, empty; fertile lemma narrow, entire or bidentate, bearing a straight or geniculate awn; pediceled spikelets awnless or with a short straight awn, the glumes of thinner texture than those of the sessile spikelets. Perennials (ours) with terminal strict or rather loose panicles.

TYPE SPECIES: *Chrysopogon Gryllus* (L.) Trin. (*Andropogon Gryllus* L.).

KEY TO THE SPECIES

1. Racemes 2–4-jointed; culms erect, 1–2 meters tall.
   2. Sessile spikelets (including the callus) 5–7 mm. long; callus up to 2 mm. long, white-bearded; racemes longer than the panicle branches.....2. *C. elongatus.*
   2. Sessile spikelets (including the callus) 8–10 mm. long; callus up to 4 mm. long, tawny-bearded; racemes, or many of them, shorter than the panicle branches.. .....3. *C. filipes.*
1. Racemes reduced to a triad of 1 sessile and 2 pediceled spikelets at the ends of the panicle branches; plants with rhizomes or stolons, the culms ascending to 20–60 cm.....1. *C. aciculatus.*

1. **Chrysopogon aciculatus** (Retz.) Trin., Fund. Agrost. 188. 1820; White, Proc. Roy. Soc. Queensl. 34: 15. 1923.

   Andropogon aciculatus Retz., Obs. Bot. 5: 22. 1789; K. Schum., Bot. Jahrb. 9: 197. 1887. Type from India.

   Rhaphis trivialis Lour., Fl. Cochinch. 2: 553. 1790; Trin., Sp. Gram. Ic. 1: *pl. 8.* 1830. Type from Cochinchina.

   Andropogon acicularis Willd., Sp. Pl. 4: 906. 1806. Based on *A. aciculatus* Retz.

   Rhaphis acicularis Desv., Opusc. 69. 1831; Hitchc., Mem. Bishop Mus. 8: 219. *fig. 107.* 1922; Chase, Jour. Arnold Arb. 20: 315. 1939.[23] Based on *A. aciculatus* Retz.

   Rhaphis aciculatus (Retz.) Honda, Bot. Mag. (Tokyo) 40: 103. 1926; Pilger, Nat. Pflanzenfam. ed. 2. 14e: 153. *fig. 82.* 1940.

Culms ascending from stout creeping rhizomes and stolons, 20–60 cm. tall; leaves densely imbricate on the rhizomes and stolons, distant on the flowering culms; sheaths terete, glabrous or sparingly bearded at the throat, the margins more or less ciliate, the culm sheaths shorter than the internodes; ligule minutely ciliolate; blades flat, rounded at the base, obtuse or subacute at the tips, 2–15 cm. long, 3–5 mm. wide, both sides glabrous or sparsely pilose at the base, the margins sparingly spinulose; panicle long-exserted, linear-oblong, usually purplish, 5–10 cm. long, the filiform branches in whorls of 4–9, about 1 cm. long or less; racemes reduced to a triad of one sessile and two pediceled spikelets; sessile spikelet linear, acuminate from about the middle, about 4 mm. long and with a long sharp rusty-bearded callus 4–6 mm. long, the callus formed by an oblique splitting of the pedicel entirely to the base of the spikelet; first glume spinulose toward the subtruncate or bimucronulate apex; second glume acuminate or aristate, the awn as much as 3 mm. long; fertile lemma entire, with a straight terminal awn 4–7 mm. long; pediceled spikelets 5–6 mm. long, the slender glabrous pedicels 2–3 mm. long.

23 Hitchcock and Chase give the binomial as "*Rhaphis aciculata* (Retz.) Desv." but Desvaux spelled the specific name "*acicularis.*"

BRITISH NEW GUINEA: Central Division: Kanosia, *Carr 11033* (US, NY) (open places); Western Division: Daru Island, *Brass 6426* (A, US) (very troublesome weed on roadsides and town allotments); Northern Division: About 9 miles northwest of Oro Bay, *Reeder 812* (A, US) (frequent in the open in wet places); Goodenough Island: Haiwali village, *Burcham 136* (US) (in vicinity of abandoned native village, mostly about bases of coconuts). NORTHEAST NEW GUINEA: Morobe District: 4 miles south of Langemak Bay, near Finschhafen, *Sawyer 144, 163* (A).

Tropical Asia to Australia, New Guinea, and Polynesia.

2. **Chrysopogon elongatus** (R. Br.) Benth., Fl. Austral. 8: 538. 1878.

Holcus elongatus R. Br., Prodr. Fl. Nov. Holl. 1: 200. 1810. Type from Australia.

Rhaphis elongatus (R. Br.) Chase, Contr. U. S. Nat. Herb. 24: 205. 1925; Hitchc. Brittonia 2: 129. 1936.

Vetiveria elongata (R. Br.) Stapf ex C. E. Hubb., Kew Bull. 1934: 444. 1934.

Culms erect, 1–2.5 meters tall, glabrous, about 7-noded; sheaths mostly longer than the internodes, glabrous or somewhat scabrous; ligule reduced to an even row of short white hairs about 0.2 mm. long; blades long-attenuate, folded for a considerable distance, as much as 50 cm. long, to 8 mm. wide, spinulose-scabrous on the margins and midrib below, otherwise glabrous and smooth, the upper surface with scattered short tubercle-based hairs; panicle pale to purplish, contracted, rather dense, 15–35 cm. long, the branches slender, rather stiff, as much as 4 cm. long; racemes 2–4-jointed, the joints 3–4 mm. long; peduncles 2–3 mm. long; sessile spikelet linear-lanceolate or linear, 5–7 mm. long including the 1.5–2 mm. long callus; the callus bearded on the margin with white or whitish hairs to 3 mm. long; glumes coriaceous, the first acute, spinulose-scabrous on the keels, the second cymbiform, mucronate or aristate with an awn as much as 2 mm. long, keeled upward, the keel spinulose-scabrous; fertile lemma with an awn as much as 12 mm. long, twisted and weakly geniculate below; pediceled spikelets slightly longer than the sessile, the glumes less firm.

BRITISH NEW GUINEA: Western Division: Daru Island, *Brass 6045* (GH, US) (heavy wet soil close behind mangrove fringe), *6283* (A, US) (pure stands on damp soils bordering large swamp); Wassi Kussa River, *Brass 8579* (A, US) (covering small tidal flats at rear of mangrove fringe); *MacGregor 46* (US).

Australia and New Guinea.

Brass 8579 was reported as *Vetiveria filipes* (Benth.) C. E. Hubb. [*Chrysopogon filipes* (Benth.) Reeder] by Chase (17, p. 315), but that species has longer panicle branches and much larger spikelets.

3. **Chrysopogon filipes** (Benth.) comb. nov.

Chrysopogon elongatus (R. Br.) Benth. var. *filipes* Benth., Fl. Austral. 7: 539. 1878. Type from Australia.

Andropogon elongatus (R. Br.) Spreng. var. *filipes* (Benth.) Hack. in DC., Monogr. Phan. 6: 565. 1889.

Vetiveria filipes (Benth.) C. E. Hubb., Kew Bull. 1934: 444. 1934.

3a. **Chrysopogon filipes** (Benth.) Reeder var. **arundinaceus** var. nov.

A typo culmis altioribus et robustioribus, ramulis paniculorum longioribus, articulis rhacheos paucioribus, gluma prima valde flava, arista glumae secundae ad 6 mm. longa differt.

Culms robust, erect, 5–8-noded, 1–1.8 meters tall, glabrous or slightly scabrous beneath the panicle; sheaths more or less scabrous on the keel,

those in the middle of the culm slightly shorter than the internodes, the basal sheaths overlapping; ligule a row of even white hairs about 0.2 mm. long; blades as much as 60 cm. long, 5–8 mm. wide, folded at the base, the margins and midnerve more or less spinulose-scabrous; panicle purplish yellow, 20–30 cm. long, contracted or rather loose, the lower branches 6–8 cm. long, flexuous, sometimes bearing 1 or 2 short branchlets; racemes 2–4-jointed, mostly shorter than the panicle branches, the joints slender, 5–15 (rarely to 20) mm. long, the pedicels usually not exceeding the sessile spikelets; sessile spikelets narrowly lanceolate, pale or stramineous, 8–10 mm. long including the sharp 2–4 mm. long callus; the callus bearded on the back and margins with tawny hairs as much as 1.5 mm. long; glumes coriaceous and muricate over the entire dorsal surface, the keels spinulose; first glume narrowly somewhat truncate, often spinulose on the upper half; second glume mucronate or with an awn as much as 6 mm. long; awn on fertile lemma 10–20 mm. long, flexuous, slightly twisted below, not or only slightly geniculate; pediceled spikelets about 6–8 mm. long, lanceolate or more or less subulate.

BRITISH NEW GUINEA: Western Division: Panzara, between Morehead and Wassi Kussa Rivers, *Brass 8460* (A, TYPE, US), December, 1936 (savannah forests, on alluvial flats of creek).

Differs from the species in being much taller and more robust, having longer panicle branches, fewer-jointed racemes, and the glumes of the sessile spikelets yellow below rather than evenly purple throughout, the second glume with an awn as much as 6 mm. long. In some respects it suggests *Vetiveria intermedia* S. T. Blake, but that species has shorter and thicker rachis joints and pedicels, the pediceled spikelets are, on the whole, less developed, and the glumes are merely scabrous or nearly glabrous on the lower half rather than uniformly muricate as in both *C. filipes* and the new variety.

The cited specimen was reported as *Vetiveria filipes* by Chase (17, p. 315).

43. **Arthraxon** Beauv.

Arthraxon Beauv., Ess. Agrost. 111. *pl. 11, fig. 6.* 1812.

Spikelets in pairs or solitary, one sessile and perfect, mostly awned, often slightly laterally compressed, at length falling with the appressed rachis joint attached, the other, when present, pediceled, neuter or rarely staminate but usually abortive with only minute pedicels remaining attached to the base of the sessile spikelets; rachis slender, usually tardily disarticulating; first glume rounded on the back, the margins more or less inrolled, usually more or less bristly-hispid on the nerves; second glume keeled, 3-nerved; lower lemma hyaline, short, empty; fertile lemma hyaline or firmer at the base, entire or minutely bidentate, with usually a well developed dorsal awn arising from near the base. Annuals or perennials with flat blades, slender weak culms and digitate or approximate racemes.

TYPE SPECIES: *Arthraxon ciliare* Beauv. = *A. hispidus* (Thunb.) Makino (*Phalaris hispida* Thunb.).

1. **Arthraxon hispidus** (Thunb.) Makino, Bot. Mag. (Tokyo) 26: 214. July, 1912[24]; Hitchc., Brittonia 2: 128. 1936.

Phalaris hispida Thunb., Fl. Jap. 44. 1784. Type presumably from Japan.

Arthraxon ciliare Beauv., Ess. Agrost. 111, 152. *pl. 11, fig. 6.* 1812. No locality given.

Pollinia ciliaris (Beauv.) Spreng., Syst. Pl. 1: 289. 1825.

Culms slender, freely branching, ascending from a decumbent base, the nodes bearded; sheaths shorter than the internodes, pubescent on the collar, the margins ciliate; ligule membranous, ciliate, 1–2 mm. long; blades ovate to ovate-lanceolate, 2–5 cm. long, 5–15 mm. wide, glabrous or pubescent, the base cordate-clasping; racemes 2 to many (rarely solitary), 2–4 cm. long; rachis joints slender, glabrous or ciliate, from half to nearly as long as the spikelet; spikelets lanceolate, 3–5 mm. long, first glume rounded on the back, several-nerved, the nerves bristly-hispid; second glume acuminate, equal to or slightly longer than the first, the keel hispid; awn of the fertile lemma usually 5–15 mm. long, geniculate and twisted; sterile pedicel reduced to a minute bristle rarely half as long as the spikelet, often obsolete.

BRITISH NEW GUINEA: Central Division: Urunu, Vanapa Valley, alt. 1900 m., *Brass 4787* (GH, US) (common on old garden land). NETHERLANDS NEW GUINEA: 9 km. northeast of Lake Habbema, alt. 2800 m., *Brass 10735* (A, US) (on a native clearing in the forest).

Tropical and temperate regions of the Old World.

44. Andropogon L.

Andropogon L., Sp. Pl. 1045. 1753, Gen. Pl. ed. 5. 468. 1754.

Spikelets in pairs at each node of an articulate rachis, or in threes at the ends of the branches, one sessile and fertile, the other pediceled, staminate or neuter (rarely perfect), sometimes reduced to a single narrow glume; rachis and pedicels of the sterile spikelets slender or sometimes thickened upward, often villous; sessile spikelet dorsally compressed; glumes membranous-coriaceous, awnless, the first rounded, flat or concave dorsally, several-nerved, the median nerve often weak or wanting; second glume cymbiform, keeled; lemmas hyaline, the lower empty; fertile lemma narrow, entire or bifid, usually bearing a slender geniculate and twisted awn, the lemma sometimes reduced to a narrow stipe-like base to the awn; pediceled spikelets awnless (rarely awned), sometimes as large as the sessile and similar to it, but usually more or less reduced. Annuals or perennials of various habitats.

TYPE SPECIES: *Andropogon distachyus* L.

KEY TO THE SPECIES AND VARIETIES

1. Racemes solitary on the culms and branches; rachis joints thickened upward with scarious cupular or toothed appendages.
   2. Sessile spikelets 2–4 (rarely to 5) mm. long; rachis joints and pedicels glabrous.
      3. Sessile spikelets 3–5 mm. long, awned.
         4. Blades 1–4 cm. long, obtuse ..... 1. *A. brevifolius.*
         4. Blades 5–9 cm. long, tapering to an acute apex ..... 1a. *A. brevifolius* var. *cryptopodus.*

24 Same combination published by Merrill in Philip. Jour. Sci. Bot. 7: 229. Sept. 1912.

3. Sessile spikelets 2 mm. long, awnless.....1b. *A. brevifolius* var. *paradoxus.*
2. Sessile spikelets 7–8 mm. long; rachis joints and pedicels ciliate..2. *A. sanguineus.*

1. Racemes 2 to several on each peduncle (sometimes solitary in *A. annulatus*).
5. Racemes 1–8-jointed; panicle branches compound, the racemes borne on branchlets of the third or fourth order.
6. Racemes reduced to one sessile and two pediceled spikelets (rarely with one or two pairs of spikelets below); first glume of sessile spikelet prominently concave dorsally.
7. Sessile spikelets awned.....3. *A. micranthus.*
7. Sessile spikelets awnless.....3a. *A. micranthus* var. *muticispiculus.*
6. Racemes 3–8-jointed; first glume of sessile spikelet not prominently concave dorsally.....4. *A. spicigerus.*
5. Racemes 10- or more jointed; panicle branches simple or rarely once branched.
8. Inflorescence paniculate, the axis 4–14 cm. long.....5. *A. intermedius.*
8. Inflorescence digitate or the racemes rarely solitary.
9. First glume long-pilose below the apex and on upper margins, the silky hairs as long as the spikelet or longer, more or less obscuring the spikelets; awn twice-geniculate.....6. *A. sericeus.*
9. First glume more or less pilose and sometimes with long tubercle-based hairs on the upper margins, but the hairs not silky and obscuring the spikelets; awn once-geniculate.....7. *A. annulatus.*

1. **Andropogon brevifolius** Swartz, Prodr. Veg. Ind. Occ. 26. 1788; Kunth, Rev. Gram. 2: *pl. 196.* 1829; Hitchc., Brittonia 2: 128. 1936; Pilger, Nat. Pflanzenfam. ed. 2. 14e: 166. *fig. 87.* 1940. Type from Jamaica.
Schizachyrium brevifolium (Swartz) Nees ex Miquel, Fl. Ind. Bat. 3: 495. 1855.
Andropogon fragilis R. Br. var. *malayanus* Merr., Enum. Philip. Fl. Pl. 1: 45. 1923. Type from the Philippines.

Annual; culms delicate, much branched, prostrate, trailing or leaning, more or less compressed, mostly 30–70 cm. long; sheaths glabrous, keeled, mostly shorter than the internodes; ligule very short, membranous, often ciliolate; blades flat, obtuse, 1–4 (rarely to 6) cm. long, 2–4 mm. wide, glabrous; racemes solitary, slender, 1–2.5 cm. long, each subtended by a glabrous sheathing spathe; rachis joints clavate, glabrous, shorter and more slender than the sessile spikelets, bidentate at summit; sessile spikelets 3–4 mm. long, the callus very short, white-bearded; first glume dorsally scaberulous, scabrous on the keels, bifid; awn of fertile lemma delicate, geniculate and twisted, as much as 1 cm. long; pediceled spikelets reduced to an awned glume 1–1.5 mm. long, the slender straight awn as much as 5 mm. long; pedicel glabrous, slightly shorter than the sessile spikelet.

BRITISH NEW GUINEA: Western Division: Dagwa, Oriomo River, alt. 40 m., *Brass 5985* (GH, US) (common on damp flats and ridge slopes); Lake Daviumbu, Middle Fly River, *Brass 7812* (A, US) (common on sour savannah slopes). NORTHEAST NEW GUINEA: Morobe District: Kajabit, Markham Valley, *Clemens 10477* (US). NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11723* (A, US) (deforested slopes; locally abundant on sandy soil).
Tropical and temperate regions of both hemispheres.

1a. **Andropogon brevifolius** Swartz var. **cryptopodus** (Ohwi) comb. nov.
Andropogon cryptopodus Ohwi, Bot. Mag. (Tokyo) 56: 10. 1942. Type from Netherlands New Guinea.

Differs from the species in the more robust habit, longer (5–9 cm.) blades tapering to an acute apex, and slightly larger spikelets.

NETHERLANDS NEW GUINEA: Momi, 60 miles south of Manokwari, alt. 10 m., *Kanehira & Hatusima 13390* (A, TYPE COLL.) (in open grass field along the track to Lake Angi).

Ohwi allies his species to *Andropogon sanguineus,* but it is much more closely related to *A. brevifolius.* The spikelets are almost identical with those of the latter species, although they tend to be slightly larger. The only important differences seem to be the somewhat more robust habit and longer blades, which are acute rather than obtuse.

Ohwi's description and type duplicate agree rather well with the description of *Andropogon brevifolius* var. *fragilis* (R. Br.) Hack. (in DC., Mongr. Phan. 6: 364. 1889). This variety is based on *A. fragilis* R. Br., but Hackel's description does not well agree with the original diagnosis by Brown (11, p. 202), in which the rachis is said to be "sericeo-barbatis." Hackel's description states "racemis gracilibus, articulis glabris." The Kanehira and Hatusima specimen cited above has glabrous rachis joints.

1b. **Andropogon brevifolius** Swartz var. **paradoxus** (Buse) Ohwi, Acta Phytotax. Geobot. 11: 169. 1942.

Schizachyrium paradoxum Buse in Miquel, Pl. Jungh. 359. 1854. Type from Sumatra.

Schizachyrium brevifolium (Swartz) Nees ex Miquel subsp. *paradoxum* (Buse) Henr., Blumea 1: 308. 1935.

Differs from the species in having awnless sessile spikelets only 2 mm. long; pediceled spikelets 0.5 mm. long, awnless or with an awn about as long as the spikelet.

BRITISH NEW GUINEA: Northern Division: 1 mile north of East Embi Lake, *Reeder 849* (A, US) (forming mats in low wet ground).

Indo-China, Sumatra, Borneo, the Philippines, and New Guinea.

2. **Andropogon sanguineus** (Retz.) Merr., Philip. Jour. Sci. Bot. 12: 101. 1917; Chase, Jour. Arnold Arb. 20: 315. 1939.

Rottboellia sanguinea Retz., Obs. Bot. 3: 25 [error for 13]. 1783. Type from China.

Andropogon pseudograya Steud., Syn. Pl. Glum. 1: 365. 1854; Hack. in DC., Monogr. Phan. 6: 370. 1889. Type from Ceylon.

Schizachyrium sanguineum (Retz.) Alston, Suppl. Fl. Ceylon 6: 334. 1931.

Culms usually tufted, erect, rather slender, 50–100 cm. tall, freely branching above, the branches appressed to the flat side of the culm; sheaths keeled, glabrous and smooth; ligule membranous, about 1.5 mm. long; blades flat, 5–20 cm. long, 1–5 mm. wide, glabrous, the margins and midrib below scabrous; racemes solitary, slender, 5–7 cm. long, shortly exserted or the lower part included in the narrow spathe; rachis joints rather slender, dilated upward, slightly shorter than the sessile spikelets, glabrous or sometimes ciliate along the outer or both margins, the base bearded with white hairs 1–2 mm. long; sessile spikelets 7–8 mm. long, narrowly linear, the first glume glabrous, tuberculate-scabrous; awn of fertile lemma up to 15 mm. long, geniculate and twisted below; pediceled spikelets reduced, about 3 mm. long, awned, the awn slender, straight, about as long as the spikelet; pedicels about as long as the rachis joints or slightly shorter, ciliate on the margins, the hairs increasing in length upward.

BRITISH NEW GUINEA: Western Division: Lake Daviumbu, Middle Fly River, *Brass 7933* (A, US) (occasional on sour savannah slopes).

India to South China, Malaysia, and New Guinea.

3. **Andropogon micranthus** Kunth, Rev. Gram. 1: 165. 1829; Hitchc., Brittonia 2: 128. 1936. Based on *Holcus parviflorus* R. Br.
Holcus parviflorus R. Br., Prodr. Fl. Nov. Holl. 1: 199. 1810. Type from Australia.
Andropogon parviflorus (R. Br.) Domin, Bibl. Bot. 85: 263. 1915 (non Roxb. 1820).
Capillipedium parviflorum (R. Br.) Stapf in Prain, Fl. Trop. Afr. 9: 169. 1917.

Perennial; culms tufted, slender, up to 1 meter or more tall, erect or ascending, simple or sparingly branched, glabrous or appressed-pubescent, especially near the nodes; nodes short-bearded; sheaths mostly shorter than the internodes, glabrous or more or less papillose-pubescent, the margins ciliate, the collar often villous; ligule very short, truncate, ciliolate; blades flat or the margins revolute, as much as 30 cm. long, 2–6 mm. wide, rather firm, the margins and upper surface scabrous, smooth to scaberulous beneath, glabrous or puberulent, often with a few long tubercle-based hairs on the upper surface near the ligule; panicle 8–25 cm. long, the branches and branchlets very slender, pubescent in their axils, otherwise usually glabrous, sometimes puberulent throughout; racemes borne on branches of the third and fourth order, 1-jointed, reduced to 1 sessile and 2 pediceled spikelets (rarely 2 or more jointed and with one or more pairs of spikelets below); sessile spikelets narrowly oblong to elliptic, 2.5–3 mm. long, the callus short-bearded; first glume hispidulous, shallowly concave on the back; fertile lemma narrow, awned, the awn geniculate, twisted, 11–16 mm. long; pediceled spikelets awnless, usually staminate (rarely neuter), similar to the sessile spikelet or more or less reduced.

British New Guinea: Central Division: Rona, Laloki River, alt. 450 m., *Brass 3558* (A, US) (common on savannah hillsides); Urunu, Vanapa Valley, alt. 1900 m., *Brass 4799* (GH, US) (common on open grasslands); ? Division: "Barowara," *MacGregor 10* (US); Quaipo, *MacGregor 20* (US). Northeast New Guinea: Morobe District: Wau, *Clemens 10458* (US) (steep grasslands above gold fields); Kajabit, Markham Valley, *Clemens 10451bis* (US) (grassland). New Britain: Cape Glouster, *Burcham 141* (US) (in open grassland).
Tropical and subtropical regions of the Old World.

MacGregor 20 has some of the racemes 3- or 4-jointed and is, in this respect, like *Andropogon spicigerus*. The first glume of the sessile spikelet, however, is rather prominently concave dorsally and has only 2 or 3 intercarinal nerves, characters which would place this specimen in *A. micranthus*.

3a. **Andropogon micranthus** Kunth. var. **muticispiculus** (Ohwi) comb. nov.
Bothriochloa parviflora (R. Br.) Ohwi var. *muticispicula* Ohwi, Tokyo Sci. Mus. Bull. 18: 13. 1947.

British New Guinea: Central Division: Kanosia, *Carr 11106, 11309* (NY) (open savannah land); Northern Division: South of Dobodura, *Reeder 801* (A, US) (common in open grassland); about 9 miles northwest of Oro Bay, *Reeder 810* (A, US) (in dense grassland; panicles open); Without precise locality: *MacGregor 52* (US). Northeast New Guinea: Morobe District: Kajabit, Markham Valley, *Clemens 10541* (US) (grassland); Ramu Valley, near the headwaters of the Markham River, *Rogers 3003* (A).

This variety appears to differ from the species in no other particular except the absence of an awn on the perfect spikelet. Examination of the extensive collections of this species in the U. S. National Herbarium

reveals no awnless specimens except those from New Guinea. The two forms apparently grow side by side, as one of the collections (*Clemens 10541*) consisted of a mixture of awned and awnless plants.

4. **Andropogon spicigerus** (S. T. Blake) comb. nov.
Capillipedium spicigerum S. T. Blake[25], Queensl. Univ. Dept. Biol. Papers 2: 43. 1944. Type from Australia.

Culms 90–120 cm. tall, slender to subrobust, erect or somewhat geniculate at base, simple or sparsely branching, glabrous or sometimes appressed-pilose, often pruinose below the nodes; sheaths terete or somewhat keeled above, glabrous to more or less papillose-hirsute; ligule truncate, ciliolate, about 0.75 mm. long; blades linear, flat or the margins revolute, as much as 40 cm. long, 5–10 mm. wide, narrowed toward the base, the apex long-attenuate, scaberulous above, glabrous beneath, the margins scabrous, the upper surface often pilose toward the base, otherwise glabrous; panicle ovate to lanceolate, purplish or rarely pale, 10–20 cm. long, the branches and branchlets slender, pubescent in their axils, otherwise glabrous or sometimes sparsely puberulent; racemes 3–8(ours mostly 4–5-)-jointed, borne on branches of the third or fourth order; joints and pedicels subequal, half to two-thirds as long as the sessile spikelets, ciliate on one or both sides; sessile spikelet oblong-lanceolate, acutish, the callus short-bearded; first glume 6–9-nerved (2–5 intercarinal nerves), dorsally more or less stiff-puberulent and slightly depressed, the keels shortly pectinate on the upper half; second glume scabrous on the keel or nearly smooth; sterile lemma hyaline, half to two-thirds as long as the glumes; fertile lemma narrow, awned, the slender awn 12–18 mm. long, geniculate and twisted below the bend; pediceled spikelets awnless, staminate or neuter, shorter and narrower than the fertile or sometimes nearly as long (in our specimens mostly neuter and reduced to small lanceolate glumes half to two-thirds as long as the sessile spikelets).

NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11616, 11805, 11845* (A, US) (common on deforested slopes).

Australia and New Guinea.

Closely related to *Andropogon micranthus* but differing in the 3–8-jointed racemes, sessile spikelet with the first glume less concave on the back and often with 4 or 5 intercarinal nerves, and the more robust habit. Blake (7, p. 45) states that there are always 4 or 5 intercarinal nerves, but our specimens, which agree well with the original description and with a type duplicate (at US) in other respects, often have only 2 or 3 intercarinal nerves; however, some of the sessile spikelets on these plants have 4 or 5 intercarinal nerves on the first glumes in the same inflorescence. The actual spikelet differences between this species and *A. micranthus* appear very slight, but the plants have a rather distinct appearance and the 3–8-jointed raceme seems quite constant. Perhaps the species would be better treated as a variety, but for the present it seems preferable to retain it as a species pending further study of collections from other parts of its range.

[25] Although Blake uses the same epithet, this is not a new combination based on *Chrysopogon parviflorus* (R. Br.) Benth. var. *spicigera* Benth. (Fl. Austral. 7: 538. 1878), but a new species based on a new type. For a detailed discussion see Blake (7, p. 43–46. 1944).

The cited specimens were all reported as *Andropogon intermedius* R. Br. by Chase (18, p. 89).

5. **Andropogon intermedius** R. Br., Prodr. Fl. Nov. Holl. 1: 202. 1810. Type from Australia.
   Bothriochloa intermedia (R. Br.) A. Camus, Ann. Soc. Linn. Lyon II. 76: 164. 1931.

Perennial; culms tufted, 50–100 cm. or more tall, erect or geniculate at base, simple or sparingly branched, glabrous, the nodes sometimes short-bearded; sheaths glabrous, terete or slightly keeled upward, mostly shorter than the internodes; ligule very short, truncate; blades flat or revolute, 10–30 cm. long, 3–6 mm. wide, smooth or scaberulous, the margins scabrous; panicle 6–15 cm. long, open, loose to somewhat dense, the axis 3–14 cm. long; branches slender, solitary or in pairs, the lower sometimes in fours, usually simple but sometimes branched, often bearded in the axils, otherwise glabrous; racemes slender, 2–5 cm. long, 10- or more jointed; joints and pedicels ciliate, the hairs up to 2.5 mm. long; sessile spikelet elliptic-oblong, obtuse, 3–4 mm. long, the callus short-bearded; first glume with 5–7 intercarinal nerves, pectinate on the upper part of the keels, dorsally depressed or sometimes with a circular pit, more or less pubescent on the lower half; awn of the narrow fertile lemma slender, 10 mm. or more long, geniculate and twisted below the bend; pediceled spikelets awnless, staminate or neuter, about as long as the sessile and similar to it but narrower.

BRITISH NEW GUINEA: Central Division: Kanosia, *Carr 11329* (NY) (open savannah land).

China to Malaysia, Australia, and New Guinea.

6. **Andropogon sericeus** R. Br., Prodr. Fl. Nov. Holl. 1: 201. 1810; Bailey, Queensl. Agric. Jour. 7(4): 350. 1900; White, Proc. Roy. Soc. Queensl. 34: 15. 1923. Type from Australia.
   Dicanthium sericeum (R. Br.) A. Camus, Bull. Mus. Hist. Nat. (Paris) 27: 549. 1921.

Perennial; culms densely tufted, erect, subrobust, 40–100 cm. tall, simple or with few to several floriferous branches from the upper nodes, often pruinose; nodes stellate-bearded; sheaths glabrous, keeled above, mostly shorter than the internodes, often pruinose like the culms; ligule membranous, ciliolate, 1–1.5 mm. long; blades flat or revolute, rigid, 10–25 cm. long, 2–5 mm. wide, glabrous below, the upper surface and margins scabrous; racemes 2–7, digitate, 2.5–5 cm. long, silky-villous; rachis joints and pedicels slender, the pedicels about half as long as the sessile spikelets, the joints slightly shorter, both ciliate, the hairs increasing in length upward; sessile spikelet oblong to ovate-oblong, about 4 mm. long; first glume obtuse, 7-nerved, pubescent on the lower half, papillose-pilose below the apex and along the margin on the upper half, the hairs equaling the spikelet or longer; awn 20–25 mm. long, twice geniculate; pediceled spikelets similar to the sessile, but awnless.

Australia.

No specimens of this species from New Guinea were seen, but it is included here since it has been reported several times. The description was based on Australian specimens.

7. **Andropogon annulatus** Forsk., Fl. Aegypt. Arab. 173. 1775; White, Proc. Roy. Soc. Queensl. 34: 15. 1923. Type from the banks of the Nile.
Dichanthium annulatum (Forsk.) Stapf in Prain, Fl. Trop. Afr. 9: 178. 1917.

Perennial; culms slender, densely tufted, erect or geniculately ascending, 50–100 cm. tall, glabrous except for the short-bearded nodes; sheaths glabrous, distinctly shorter than the internodes, slightly keeled above; ligule membranous, ciliolate, 0.5–1.5 mm. long; blades narrowly linear, 5–15 cm. long, 1.5–3 mm. wide, flat or revolute, the margins and lower surface scaberulous, the upper surface often sparsely pilose with tubercle-based hairs; racemes 1–5, digitate, 2–5 cm. long, spikelet-bearing to the base; rachis joints and pedicels subequal or the joints shorter, slender, about half as long as the sessile spikelets or shorter, ciliate, the hairs increasing in length upward; sessile spikelet oblong-elliptic, obtuse, about 4 mm. long; first glume prominently nerved, more or less pilose, sometimes with long tubercle-based hairs especially near the margins above; awns slender, 15–20 mm. long, geniculate and twisted below the bend; pediceled spikelets similar to the sessile but awnless.

BRITISH NEW GUINEA: Central Division: Port Moresby, *Brass 8787* (A, US) (common on roadsides); Western Division: Daru Island, *Brass 6404* (A, US) (growing about the wharf, apparently of recent introduction).

Africa to India, China, Australia, and New Guinea.

The cited specimens were reported as *Andropogon annulatus* var. *monostachys* F. Muell. ex Benth., by Chase (17, p. 315), but examination of a type fragment (at A) reveals that this variety has much larger spikelets and the racemes are stouter. This form has been described as a species under the genus *Dichanthium* (*D. fecundum*) by S. T. Blake (7, p. 51. 1944). In his discussion under this species, Blake states (op. cit. p. 54) that the pediceled spikelets usually are perfect and contain a well developed pistil. The pistil produces a grain and seems to be equally fertile to that of the sessile spikelet. These pediceled spikelets commonly have also a well developed geniculate and twisted awn, he states. Blake's new species is apparently confined to Australia.

45. **Cymbopogon** Spreng.

Cymbopogon Spreng., Pl. Pugill. 2: 14. 1815.

Racemes in pairs, one sessile, the other short-peduncled, included in an inflated spathe, the spathes in a large compound inflorescence; spikelets paired as in *Andropogon*, but the lower pair, in one or both racemes, homogamous (both awnless, staminate or neuter), otherwise the sessile spikelet perfect, usually awned, the pediceled spikelet staminate, awnless; rachis fragile, the joints falling attached to the sessile spikelet, the callus short, blunt; sessile spikelet more or less dorsally compressed; glumes membranous-chartaceous, the first flat or rounded on the back, rather prominently two-keeled, the margins inflexed; second glume wing-keeled toward the apex; lemmas hyaline or the lower thinly membranous, the fertile bearing a twisted geniculate awn with a glabrous column (rarely awnless). Robust often aromatic perennials with simple culms below the spathaceous inflorescences. This genus includes the oil grasses of commerce.

TYPE SPECIES: *Cymbopogon Schoenanthus* (L.) Spreng. (*Andropogon Schoenanthus* L.).

1. **Cymbopogon procerus** (R. Br.) Domin, Bibl. Bot. 85: 273. 1915; Hitchc., Brittonia 2: 128. 1936.

   Andropogon procerus R. Br., Prodr. Fl. Nov. Holl. 1: 202. 1810. Type from Australia.

Culms erect, 1–2.5 meters tall, glabrous or sometimes more or less pubescent below the nodes; sheaths glabrous, shorter than the internodes; ligule membranous, 3–4 mm. long, more or less erose or ciliate at summit; blades as much as 90 cm. long, 5–20 mm. wide, attenuate at the base, usually somewhat involute, glabrous on both surfaces, the margins scabrous; panicle 15–30 cm. long, narrow, dense, with numerous short branches, the acuminate cymbiform spathes about equal to or longer than the 1.5–2 cm. long racemes; rachis joints and pedicels equal, rather slender, about half as long as the sessile spikelet, clothed with spreading silky hairs, those on the upper part up to 3 mm. long; lowermost pair of spikelets on the sessile raceme homogamous, awnless, reduced to a many-nerved first glume 3–4 mm. long or sometimes with a short second glume enclosed, the pediceled spikelets throughout the inflorescence of the same nature; sessile spikelet about 4 mm. long including the short-bearded callus; first glume lanceolate, 5–6-nerved, the nerves prominent above, becoming obscure toward the base, the keels narrowly winged toward the obtuse or bifid apex; second glume cymbiform, equal to the first, about 5-nerved, narrowly wing-keeled toward the summit, the margins ciliate; lemmas subequal, about one-fourth shorter than the glumes, the lower empty, thinly membranous, the margins ciliate; fertile lemma hyaline, cleft to the middle and bearing a twisted and geniculate awn from the base of the cleft, the awn about 12 mm. long, the brownish column about 5 mm. long.

BRITISH NEW GUINEA: Central Division: Baroka, Nakeo District, alt. 50 m., *Brass 3713* (GH, US) (small scattered tufts); Western Division: Wuroi, Oriomo River, alt. 10–30 m., *Brass 5725* (GH, US) (on savannah at about its junction with the rain-forest); Daru Island, *Brass 6364* (A, US) (uncommon on drier soils of savannah forests); Gaima, Lower Fly River, *Brass 8370* (A, US) (clumps in denser savannah forest).

Australia and New Guinea.

The cited specimens agree with the short original description, and, in general, with the more detailed description by Hackel (23, p. 94). While Hackel states that there are no nerves between the keels on the first glume, the New Guinea specimens have 3 or 4 nerves which are rather prominent above and obscure below, and the keels are very narrowly winged. The specimen cited as *Andropogon Nardus* L. var. *grandis* Hack. by C. T. White (75, p. 15) may be this species.

Cymbopogon flexuosus (Nees ex Steud.) Stapf, Kew Bull. 1906: 319. 1906.

Andropogon flexuosus Nees ex Steud., Syn. Pl. Glum. 1: 388. 1854. Type from India.

Andropogon Nardus L. var. *flexuosus* (Nees ex Steud.) Hack. in DC., Monogr. Phan. 6: 603. 1889; K. Schum., Notizbl. Bot. Gart. Berlin 2: 91. 1898; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 173. 1901.

This is one of the Citronella or Lemon Grasses. It has been cultivated by the colonists and by the natives of New Britain, according to the above

reports. This species is characterized by its large, loose, greyish or slate colored panicles with very slender long flexuous and often drooping branches and usually very slender acute spikelets. No specimens from this region have been seen.

46. **Hyparrhenia** Anderss.

Hyparrhenia Anderss., Nova Acta Soc. Sci. Upsal. III. 2: 231, 244, 254. 1856, nomen; in Schweinf., Beitr. Fl. Aethiop. 300. 1867, nomen; Fourn., Mex. Pl. 2: 51, 67. 1886, sine descr.; Stapf in Prain, Fl. Trop. Afr. 9: 291. 1918, descr.

Racemes in pairs, one sessile, the other short-peduncled, subtended by a narrow sheathing spathe, the spathes in a large compound inflorescence; spikelets paired, the lowest pair in one or both racemes homogamous, staminate or neuter as in *Cymbopogon*, but the sessile perfect spikelet disarticulating obliquely, leaving a sharp-pointed callus and the awn of the fertile lemma hirtellous below the bend; glumes membranous-chartaceous, the first sometimes dorsally grooved, with inflexed margins, but the edges rounded, not sharply keeled; second glume cymbiform, rounded below, somewhat keeled toward the summit; pediceled spikelets often with the first glume short-awned. Perennials, not aromatic, with compound spatheate panicles.

TYPE SPECIES: *Hyparrhenia pseudocymbaria* (Steud.) Stapf.

1. **Hyparrhenia bracteata** (Humb. & Bonpl. ex Willd.) Stapf in Prain, Fl. Trop. Afr. 9: 360. 1918; Hitchc., Brittonia 2: 128. 1936; Pilger, Nat. Pflanzenfam. ed. 2. 14**3**: *fig. 94*. 1940.

Andropogon bracteatus Humb. & Bonpl. ex Willd., Sp. Pl. 4: 914. 1806. Type from Cumana [Venezuela].

Cymbopogon bracteatus (Humb. & Bonpl. ex Willd.) Hitchc., Contr. U. S. Nat. Herb. 17: 209. 1913.

Culms erect, tufted, 60–200 cm. tall; sheaths hirsute or the upper glabrous, the basal densely villous; ligule membranous, about 2–3 mm. long, ciliate or often erose; blades linear, as much as 60 cm. long, 3–6 mm. wide, flat or more or less convolute, glabrous above, the lower surface more or less pubescent; panicle narrow, 20–40 cm. long; spathes 2–4 cm. long, reddish brown, glabrous or nearly so; racemes about 1 cm. long, the common peduncle slender, exserted from the side of the spathe, clothed with yellow spreading papillose-based hairs, the racemes finally divergent or reflexed, one of them sessile with a pair of homogamous sterile awnless spikelets at base and above them one perfect sessile long-awned spikelet and two sterile awnless pediceled spikelets, the other raceme similar but short-peduncled and without the pair of homogamous spikelets at base; perfect spikelet 6–7 mm. long including the sharp-pointed callus, dorsally glabrous, the callus and slender pedicels clothed with short white hairs, the awn of the fertile lemma 2.5–4 mm. long, geniculate in the middle, the column hirtellous; sterile spikelets similar but the first glume with a short straight awn 1–2 mm. long.

BRITISH NEW GUINEA: Central Division: Urunu, Vanapa Valley, alt. 1500 m., *Brass 4817* (A, US) (one of the commonest of open grassland species).

Tropical America, tropical Africa, Indo-China, China, and New Guinea.

The cited specimens are overmature and most of the spikelets have fallen. They are, however, complete enough for fairly accurate compari-

son and seem to be identical with plants of this species from China. They are slightly smaller than the South American plants and have glabrous rather than appressed-hirsute spathes.

47. **Themeda** Forsk.

Themeda Forsk., Fl. Aegypt. Arab. 178. 1775.

Spikelets in pairs, or in threes in the terminal rachis joints, the lowermost two pairs of the raceme homogamous, staminate or neuter, awnless, closely approximate and appearing verticillate or like an involucre, the remaining 1–3 pairs heterogamous, one sessile and perfect, the other pediceled, staminate or neuter; fertile spikelets terete, usually awned (rarely awnless), obliquely disarticulating with a sharp rufous-bearded callus; racemes solitary in each proper spathe, these aggregated in flabellate clusters or solitary in the axils. Perennials or annuals with compound or simple spatheate panicles.

TYPE SPECIES: *Themeda triandra* Forsk.

KEY TO THE SPECIES AND VARIETIES

1. Involucral spikelets sterile, reduced to a single thin, membranous glume; plants annual.....1. *T. frondosa.*
1. Involucral spikelets with two well developed glumes, often staminate; plants perennial.
   2. Involucral spikelets borne at the same level; culms slender; midrib of blades thin, fine.....2. *T. triandra.*
   2. Involucral spikelets borne at different levels; culms robust; midrib of blades broad, conspicuous.
      3. Involucral spikelets clothed with golden or brown tubercle-based hairs; fertile spikelets awnless or with a short straight awn 10 mm. long or less.
         4. Involucral spikelets 6.5–8 mm. long; fertile spikelets 6.5–7 mm. long including the callus; first glume sparsely puberulent, prominently 5–7-nerved.....3. *T. gigantea.*
         4. Involucral spikelets 10–13 mm. long; fertile spikelets 9–10 mm. long including the callus; the first glume densely puberulent with golden or brownish hairs.....3a. *T. gigantea* var. *amboinensis.*
      3. Involucral spikelets glabrous or scaberulous; fertile spikelets awned, the awn 2.5–3 cm. long, geniculate and twisted....3b. *T. gigantea* var. *novoguineensis.*

1. **Themeda frondosa** (R. Br.) Merr., Bur. Sci. Publ. Manila 9: 89. 1917; Chase, Jour. Arnold Arb. 20: 316. 1939.

   Anthisteria frondosa R. Br., Prodr. Fl. Nov. Holl. 1: 200. 1810. Type from Australia.

   Themeda arguens sensu Hack. in DC., Monogr. Phan. 6: 657. 1889 (non *Stipa arguens* L.).

Annual; culms erect to geniculately ascending, more or less compressed, often rooting from the lower nodes, 60–120 cm. tall (to 3 meters fide Hackel); sheaths keeled, much shorter than the internodes, glabrous to more or less papillose-hirsute; ligule membranous, 1–2 mm. long, rounded-truncate; blades flat, 10–40 cm. long, 4–6 mm. wide, glabrous to more or less pilose above toward the base, smooth below, the upper surface and margins scaberulous to scabrous; panicle one-third to half the length of the plant, strongly interrupted, composed of 2 or 3 remote nodes, the branches solitary to binate and bearing numerous fascicled branchlets,

these capitate, each head bearing 6–20 fertile racemes and often several sterile ones; proper spathes 3.5–4 cm. long, long-attenuate, glabrous to more or less papillose-pilose toward the base; racemes about 1.5 cm. long, bearing 1 fertile spikelet; involucral spikelets 8–10 mm. long, reduced to one thin membranous glume, this acute, bi- or tricuspidate, 5–7-nerved, one or both margins broadly scarious-winged; perfect spikelets 8–10 mm. long, including the 3–4 mm. long callus; the callus sharp-pointed, curved, glabrous dorsally, the sides and ventral part densely bearded, the hairs at first golden, becoming brown when mature, extending to about the middle of the spikelet; glumes hispid to tuberculate-scabrous above, smooth below; awn stout, 7–9 cm. long, geniculate and twisted, puberulent below the bend.

BRITISH NEW GUINEA: Western Division: Mabaduan, *Brass 6474* (A, US) (locally abundant on sandy soil in savannah forests).

Philippines to Malaysia, Australia, and New Guinea.

2. **Themeda triandra** Forsk., Fl. Aegypt. Arab. 178. 1775; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 173. 1901; C. E. Hubb., East. Afr. Pasture Pl. 28. *fig. 15.* 1926; Blatter & McCann, Imp. Council Agric. Res. Sci. Monogr. 5: 115. *pl. 74.* 1935; Pilger, Nat. Pflanzenfam. ed. 2. 14e: 179. *fig. 95.* 1940. Type from Arabia.

Anthistiria imberbis Retz., Obs. Bot. 3: 11. 1783; C. T. White, Proc. Roy. Soc. Queensl. 34: 15. 1923. No locality is given.

Anthistiria australis R. Br., Prodr. Fl. Nov. Holl. 1: 200. 1810; K. Schum., Bot. Jahrb. 9: 197. 1889. Type from Australia.

Anthistiria Forskalii Kunth, Rev. Gram. 1: 162. 1829.[26]

Anthistiria vulgaris Hack., Nat. Pflanzenfam. II. 2: 29. *fig. 20.* 1887[27]; K. Schum. & Hollr., Fl. Kais. Wilhelmsland 22. 1889.

Themeda Forskalii (Kunth) Hack. in DC., Monogr. Phan. 6: 659. 1889, Bot. Jahrb. 13: 261. 1890.

Themeda australis (R. Br.) Stapf in Prain, Fl. Trop. Afr. 9: 420. 1919.

Perennial; culms rather slender, erect or geniculately ascending, terete or subcompressed, glabrous, often pruinose below the nodes; sheaths overlapping below, shorter than the internodes in the upper part of the culm, keeled, glabrous or more or less papillose-hispid or pilose; ligule membranous, ciliolate, 1–1.75 mm. long, rounded-truncate; blades with a thin fine midrib, linear, 10–40 cm. long, 2–7 mm. wide, usually glabrous beneath, the margins and upper surface often papillose-pilose; panicle narrow, one-fourth to one-third the length of the plant; racemes 12–18 mm. long on peduncles 1–5 mm. long; the involucral spikelets borne at the same level, glabrous or with scattered stiff tubercle-based hairs; fertile spikelets 6–9 mm. long including the brown hairy callus, dorsally glabrous, hispidulous toward the apex; awns 3–6 mm. long, twisted and geniculate, the column puberulent.

[26] Kunth gives as the basis of this name *Themeda polygama* Forsk., but there is no *T. polygama* in Forskal's work. There is a *T. polygama* Gmel. (Syst. Nat. 2: 149. 1791) in which the reference is: "Forsk. Fl. aeg. arab. p. 178." The only species of *Themeda* in that work is *T. triandra* Forsk.

[27] Hackel gives no description, but there is an excellent plate. He states: "*A. ciliata* der Autoren, nicht L. fil." The distribution is given as from Syria to Algeria to Capeland and Tasmania, the "Kangaroo Grass" of the Australian farmer. In DC., Monogr. Phan. 6: 659. 1889, Hackel reduces this species to *Themeda Forskalii* (Kunth) Hack. = *T. triandra* Forsk.

British New Guinea: Central Division: Budotobara, alt. about 100 m., *Brass 765* (GH, US) (a dominant species on dry savannahs); Rona, Laloki River, alt. 450 m., *Brass 3692* (A, US) (common savannah grass); Baroka, Nakeo District, alt. 50–100 m., *Brass 3723* (the dominant grass on higher ridges in this locality); Kanosia, *Carr 11133* (NY) (open savannah land); Northern Division: About 9 miles northwest of Oro Bay, *Reeder 803* (A, US) (bunchgrass, common in grasslands); Western Division: Wuroi, Oriomo River, alt. 10–30 m., *Brass 5873* (rare, scattered on banks of a savannah stream); Dagwa, Oriomo River, alt. 40 m., *Brass 5927* (A, US) (the dominant species on large areas of open ridges); Daru Island, *Brass 6269* (A, US) (dominant grass over most of savannah forest). Northeast New Guinea: Morobe District: Ramu Valley, near the headwaters of the Markham River, *Rogers 3004* (A). Netherlands New Guinea: West of Hollandia, *Sigafoos 28* (A). Solomon Islands: Guadalcanal: Berande, *Brass 2551* (GH) (the principal species on the extensive grassy slopes peculiar to the west side of the Island); Florida: *Brass 3241* (GH) (stony hillsides, common, grows in tussocks).

Widely distributed in tropical and temperate regions of the Old World.

3. **Themeda gigantea** (Cav.) Hack. in DC., Monogr. Phan. **6:** 670. 1889; K. Schum., Notizbl. Bot. Gart. Berlin **2:** 92. 1898.

Anthistiria gigantea Cav., Ic. Pl. 5: 36. *pl. 458.* 1799; F. Muell., Pap. Pl. **2:** 51. 1886. Type from the Philippines.

Perennial; culms caespitose, erect, 1.5–4 meters tall, robust, glabrous, terete or subcompressed, unbranched below the inflorescence, often pruinose below the nodes; sheaths shorter than the internodes, compressed, keeled, glabrous or somewhat pubescent on the upper margins; ligule short, truncate to rounded, membranous, ciliolate; blades lanceolate-linear to narrowly linear, 30–100 cm. long, 5–25 mm. wide, flat or canaliculate, rigid, erect, scabrous above, often glaucous below, the margins serrulate-scabrous, the midrib broad, prominent; panicle ample, as much as 1 meter or more long; spathes 1–1.2 cm. long; racemes divergent, about 1 cm. long, borne on peduncles 1–2 mm. long; involucral spikelets 6.5–8 mm. long, borne at different levels, the first glume clothed with golden or brownish tubercle-based hairs; perfect spikelets awnless, usually solitary in each raceme, 6.5–7 mm. long including the 1.5 mm. long callus, sparsely puberulent, the first glume distinctly 5–7-nerved.

Solomon Islands: Florida: N'Gela, *Brass 3518* (GH) (growing here and there along the foreshores; very tall, coarse tussock grass).

A wide ranging polymorphic species. The above description applies to Hackel's subsp. *genuina* var. *genuina*.

3a. **Themeda gigantea** (Cav.) Hack. var **amboinensis** Hack. in DC., Monogr. Phan. **6:** 673. 1889.

Racemes 1.5–2 cm. long; peduncles 5–7 mm. long, pilose with yellowish or brownish hairs at least on the upper half; spathes glabrous, 2–3.5 cm. long; involucral spikelets 10–13 mm. long, the first glume clothed with yellowish to brownish tubercle-based hairs; perfect spikelets densely puberulent with golden or brownish hairs, 9–10 mm. long including the 2 mm. long callus, 1 or 2 in each raceme, awnless or with a short straight awn as much as 10 mm. long.

British New Guinea: Central Division: Bisiatabu, alt. about 470 m., *Brass 634* (A, US) (tall coarse grass 6–8 ft. high on dry savannahs); Gulf Division: Kerema, *Brass 1205* (GH, US) (open grassland near the coast); Western Division: Daru Island, *Brass 6382* (A, US) (about edges of rain forest second

growths, not common; in clumps about 3 meters high); Lake Daviumbu, Middle Fly River, *Brass 7768* (A) (a solitary specimen in an overgrown garden clearing). NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11678* (A, US) (plentiful along old dykes and other well drained situations on river plain; clumps up to 3 meters high). NEW BRITAIN: *R. Parkinson 64* (US). SOLOMON ISLANDS: San Cristoval: Waimamura, *Brass 2857, 3126* (GH) (small area of natural grassland; rare; tall robust species).

Netherlands Indies to New Guinea.

Distinguished from the species by the longer spathes, longer peduncles, larger involucral spikelets, and the larger perfect spikelets, which are often borne two in each raceme.

3b. **Themeda gigantea** (Cav.) Hack. var. **novoguineensis** var. nov.

A typo differt spiculis masculinis dorso glabris vel scaberulis, haud ferrugineis vel brunneis basi tuberculatis patentibus dense hirsutis; spiculis hermaphroditis aristatis, aristis 2.5–3 cm. longis. A subsp. *caudata* Hackelii spiculis hermaphroditis in utroque racemo paucioribus et paullo brevioribus, spiculis masculinis brevioribus differt.

Racemes about 1.5 cm. long bearing usually 1 (rarely 2) perfect spikelets; involucral spikelets 8–9 mm. long, scabrous on the keels, otherwise scaberulous; perfect spikelets brown, 7–9 mm. long including the 2–3 mm. long callus, dorsally puberulent-hispidulous, the hairs sometimes obscure toward the base; fertile lemma awned, the awn brown, 2.5–3 cm. long, geniculate at about the middle, the column puberulent-hispidulous.

BRITISH NEW GUINEA: Central Division: Astrolabe, *Armit 44* (US); Rona, Laloki River, alt. 450 m., *Brass 3589* (A, US) (very tall robust species; leaves glaucous when young); Baroka, Nakeo District, alt. 50 m., *Brass 3710* (GH, TYPE, US), April, 1933 (the dominant grass on the lower *Eucalyptus* forest ridges; grows in large leafy clumps up to 3 meters high; leaves glaucous green); Port Moresby, alt. 200 m., *Brass 8782* (A, US) (open savannah forest; dominant grass on stony hillsides; clumps 1.5–2 meters high); Kanosia, alt. about 30 m., *Carr 11235* (US, NY) (on open grassland; grass about 10 ft. tall).

Differs from the species in having involucral spikelets glabrous to scaberulous rather than pilose with reddish or brownish tuberculate-based spreading hairs, and in the awned fertile lemma. This variety is perhaps closest to subsp. *caudata* Hack., but in that the racemes bear 2 or 3 fertile spikelets, which are 9–11 mm. long, and involucral spikelets 12–15 mm. long.

Brass 8782 was reported as *Themeda australis* (R. Br.) Stapf by Chase (17, p. 316), but that species (treated here as a synonym of *T. triandra*) has involucral spikelets borne at the same level and the perfect spikelets dorsally glabrous, hispidulous only toward the apex.

48. **Germainia** Bal. and Poitr.

Germainia Bal. and Poitr., Bull. Soc. Hist. Nat. Toulouse 7: 344. 1873.

Racemes long-exserted, solitary, capitulate, terminating the culms, composed of 3–6 sessile marginal staminate spikelets, the broad coriaceous first glumes forming an urn-like receptacle enclosing the long-awned perfect pediceled spikelets; sessile staminate spikelets 2-flowered, the second glume and lemmas membranous-hyaline; pediceled perfect spikelets terete or

somewhat flattened, disarticulating obliquely with a sharp bearded callus, the glumes chartaceous-indurate; fertile lemma bearing a long stout twisted and geniculate awn; slender erect perennials with flat blades.

TYPE SPECIES: *Germainia capitata* Bal. and Poitr.

1. **Germainia capitata** Bal. and Poitr., Bull. Soc. Hist. Nat. Toulouse 7: 345. *fig. 1–9*. 1873; Hitchc., Brittonia 2: 129. 1936.

Culms tufted, erect, 50–70 cm. tall, simple, glabrous, the nodes bearded; sheaths mostly slightly shorter than the internodes, keeled above and more or less densely pilose; ligule membranous, 1–1.5 mm. long; blades flat, linear, 10–25 cm. long, 3–5 mm. wide, both surfaces pubescent to pilose; racemes (excluding the awns) 15–20 mm. long, 3–8 mm. wide, terete, stramineous to tawny; sessile spikelets about 18 mm. long, the first glume slightly shorter, truncate, emarginate, usually ciliate, the second glume and lemmas puberulent toward their tips; fertile spikelets brown-hirtellous, the awn about 6 cm. long, geniculate in the upper third, the column brownish hirsute.

BRITISH NEW GUINEA: Western Division: Wuroi, Oriomo River, alt. 10–30 m., *Brass 5727* (GH, US) (sporadic in small tufts on savannah ridges); Mabaduan, *Brass 6555* (A, US) (scattered in savannah forests); Wassi Kussa River, *Brass 8637* (A, US) (common on sub-acid soils of savannah forests); *MacGregor 7* (US). NETHERLANDS NEW GUINEA: Balim River, alt. 1600 m., *Brass 11722* (A, US) (usually dominant grass on sandy soil of deforested slopes).

India to China and New Guinea.

49. Heteropogon Pers.

Heteropogon Pers., Syn. Pl. 2: 533. 1807.

Spikelets in pairs, the lower 1-several pairs homogamous, staminate or neuter, imbricate, persistent along the continuous rachis, the remaining pairs heterogamous, one sessile, perfect or pistillate, terete, long-awned, the other pediceled, staminate or neuter, similar to the homogamous spikelets below, the upper part of the rachis disarticulating obliquely at the base of each joint and forming a sharp barbed callus below the fertile spikelet, the pediceled spikelet readily falling, its pedicel obscured in the hairs of the callus; staminate spikelets awnless, the glumes membranous; first glume asymmetrical, one submarginal keel rather broadly winged, the other wingless; second glume narrower, symmetrical; lemmas hyaline, epaleate; fertile spikelets terete, the glumes coriaceous, the first brown-hirsute, enfolding the second; lemmas hyaline; awn of the fertile spikelets stout, twice geniculate, twisted and hirsute below the upper bend. Perennials or annuals with solitary spikelike cylindrical racemes terminating the culms and upper branches.

TYPE SPECIES: *Heteropogon glaber* Pers. = *H. contortus* (L.) Beauv. (*Andropogon contortus* L.).

KEY TO THE SPECIES

1. Fertile spikelets 6–8 mm. long including the 2 mm. long callus; plants 30–90 cm. tall.....1. *H. contortus.*
1. Fertile spikelets 12–14 mm. long including the 6 mm. long callus; plants robust, 1.5–3 meters tall.....2. *H. triticeus.*

1. **Heteropogon contortus** (L.) Beauv. ex. Roem. & Schult., Syst. Veg. 2: 836. 1817; C. T. White, Proc. Roy. Soc. Queensl. 34: 15. 1923; Hitchc., Lingnan Sci. Jour. 7: 250. *pl. 11.* 1931, U. S. Dept. Agric. Misc. Publ. 200: 756. *fig. 1677.* 1935; Brittonia 2: 129. 1936.

Andropogon contortus L., Sp. Pl. 1045. 1753; F. Muell., Pap. Pl. 1: 46. 1876. Type from India.

Heteropogon hirtus Pers., Syn. Pl. 2: 533. 1807. Based on *Andropogon contortus* L.

Perennial; culms tufted, erect, branching above, 30–90 cm. tall; sheaths compressed-keeled, glabrous; ligule membranous, about 1 mm. long, ciliate; blades linear, flat or folded, 3–6 mm. wide, scaberulous at least above and on the margins; racemes 3–7 cm. long, dorsiventral, straight or slightly curved; sessile spikelets 6–8 mm. long including the 2 mm. long callus, pubescent, dark brown, nearly hidden by the imbricate pediceled spikelets, the awn 6–10 cm. long; sterile spikelets with the first glume papillose-hispid toward the margins and the tip or sometimes nearly glabrous.

BRITISH NEW GUINEA: Central Division: Rona, Laloki River, alt. 450 m., *Brass 3632* (GH, US) (one of the principal grasses of the lowland savannahs; not plentiful at this altitude); Kanosia, *Carr 11174* (NY) (open savannah land). NORTHEAST NEW GUINEA: Morobe District: Kajabit, *Clemens 10713e, 10515* (US).

Tropical and warmer regions of both hemispheres.

2. **Heteropogon triticeus** (R. Br.) Stapf, Kew Bull. 1912: 432. 1912; Chase, Jour. Arnold Arb. 20: 316. 1939.

Andropogon triticeus R. Br., Prodr. Fl. Nov. Holl. 1: 201. 1810; Hack. in DC., Monogr. Phan. 6: 588. 1889. Type from Australia.

Perennial; culms robust, erect, 1.5–3 meters tall, glabrous; sheaths glabrous or nearly so, the lower overlapping, compressed-keeled, the upper shorter than the internodes, rounded or somewhat keeled above; ligule 1–1.5 mm. long, membranous, irregularly ciliate; blades usually folded (at least when dry), 40–60 cm. long, gradually tapering to the attenuate apex, more or less scabrous, at least on the margins, the upper surface sometimes sparsely pilose; racemes dorsiventral, similar to those of *Heteropogon contortus*, but considerably larger, as much as 15 cm. long exclusive of the awns; sessile spikelet 12–14 mm. long, including the 6 mm. long callus, puberulent, dark brown, almost completely hidden by the imbricate pediceled spikelets, the awn stout, 10–16 cm. long; glumes of sterile spikelets glabrous.

BRITISH NEW GUINEA: Western Division: Mabaduan, *Brass 6538* (A, US) (of localized distribution on drier soils of savannah forest, dominant where it occurs).

India to Malaysia, Australia, and New Guinea.

A much larger, coarser, more robust species than *Heteropogon contortus*. The leaf blades are long, firm and attenuate, while those of *H. contortus* are usually flat and thinner in texture. The inflorescences of these two species are very similar, but that of *H. triticeus* is larger and coarser with larger spikelets.

Tribe III. MAYDEAE

Spikelets unisexual, dissimilar, awnless, the sexes in different inflorescences or in different parts of the same inflorescence, the pistillate below; staminate spikelets 2-flowered, usually paired, one sessile, the other pedi-

celed, in solitary or panicled spikelike racemes; sessile spikelets 2-flowered, the lower floret sterile, solitary or sometimes accompanied by a pediceled staminate spikelet, embedded in hollows of a thickened articulate axis, enclosed in a thickened sheath, or crowded in rows on a thickened axis (cob); glumes membranous or indurated, lemmas hyaline. Annuals or perennials with usually tall culms and broad flat leaves.

KEY TO THE GENERA

1. Staminate and pistillate spikelets in separate portions of the same inflorescence, the pistillate below.
   2. Spikes elongate, the pistillate portion several to many-flowered, disarticulating into as many 1-seeded joints.....50. *Polytoca.*
   2. Spikes short, the pistillate portion 1–3-flowered, permanently enclosed within a shiny bead-like sheathing bract.....51. *Coix.*
1. Staminate and pistillate spikelets in separate inflorescences, the staminate in a terminal panicle, the pistillate borne in axils of the leaves.....52. *Zea.*

50. **Polytoca** R. Br.

Polytoca R. Br. in Bennett, Pl. Jav. Rar. 20. *pl. 5.* 1838.

Spikelets unisexual, in the lower part of the raceme one sessile and pistillate, more or less sunken in the rachis, the other pediceled and staminate (in ours) or more or less reduced; spikelets in the upper part of the raceme all staminate (often the uppermost racemes entirely staminate); rachis of the staminate part of the raceme continuous, falling entire, of the lower pistillate part fragile, disarticulating into as many 1-seeded joints as there are spikelets; glumes of the staminate spikelets membranous or chartaceous, those of the pistillate spikelets coriaceous. Tall robust perennials with flat blades and terminal and lateral spikelike racemes borne in the upper sheaths.

TYPE SPECIES: *Polytoca barbata* R. Br. = *P. digitata* (L. f.) Henr. (*Apluda digitata* L. f.).

1. **Polytoca macrophylla** Benth., Jour. Linn. Soc. Bot. **19:** 52. 1881; Hack., Bot. Jahrb. **13:** 263. 1890; Henr., Med. Rijks Herb. Leiden **67:** 12. *fig. 1, 2.* 1931; Pilger, Nat. Pflanzenfam. ed. 2. **14e:** 186. 1940. Type from the Louisiade Archipelago.

Culms caespitose, robust, freely branching, 2–3 meters tall, erect or somewhat geniculate at base and rooting from the lower nodes; sheaths slightly shorter than the internodes, glabrous or more or less papillose-hispid near the margins; ligule wanting or very short; blades flat, as much as 90 cm. long and 8 cm. wide, smooth and glabrous, the margins scabrous; rachis joints in the lower part of the raceme 5–7 mm. long, clavate and somewhat concave on the side next to the sessile spikelet, more or less pubescent on the back, especially toward the base; pistillate spikelets lanceolate, more than 1 cm. long, the first glume glabrous but minutely papillose-roughened on the back above the smooth callus, scabrous on the upper margins; pedicels of the pediceled staminate spikelets fused to the rachis joint for more than half their length; staminate spikelets about as large as the pistillate in the lower part of the raceme, reduced in size upward.

BRITISH NEW GUINEA: Central Division: Rona, Laloki River, alt. 450 m., *Brass 3617* (GH, US) (rocky savannah slopes; tall erect species growing in clumps;

hairs stiff and irritant); Mafulu, alt. 1250 m., *Brass 5485* (US) (massed in an old native garden); Kanosia, *Carr 11344* (NY) (river bank); Gulf Division: Kerema, *Brass 1203* (GH, US) (open ridges near coast; tall clumps of grass 5 ft. high); Northern Division: About 13 miles northwest of Oro Bay, *Reeder 842* (A, US) (low ground at edge of swamp); Goodenough Island: Haiwali, *Burcham 126* (US) (edge of clearing in rain forest). NORTHEAST NEW GUINEA: Morobe District: Kajabit, Markham Valley, *Clemens 10552A* (US) (growing on stream margins; plants 10 ft. or more tall); Boana, *Clemens 41608* (US). NETHERLANDS NEW GUINEA: Mamberamo, Otken River, alt. about 60 m., *Docters van Leeuwen 11368* (GH, NY). BISMARCK ARCHIPELAGO: Duke of York Islands: *W. Bradthe 5* (US); New Britain: Rabaul, *Herre 198* (NY) (growing on roadsides; plants 10 ft. high). SOLOMON ISLANDS: San Cristoval: Waimamura, *Brass 2629* (GH) (on old village and garden clearings; blades to 8 cm. wide); Bougainville: Kugumaru, *Kajewski 1989* (GH) (a pest in native gardens).

Ternate to New Guinea and the Louisiade Archipelago.

The report by F. Muell. (Pap. Pl. 2: 20. 1885) of *Chionachne cyathopoda* (F. Muell.) Benth. = *Polytoca cyathopoda* (F. Muell.) Bailey is probably referable to this species.

51. Coix L.

Coix L., Sp. Pl. 972. 1753, Gen. Pl. ed. 5. 419. 1754.

Spikelets unisexual; staminate spikelets 2–flowered, in twos and threes on a slender continuous rachis; glumes membranous, lanceolate, obscurely nerved; lemmas and paleas hyaline, the stamens 3; pistillate spikelets 3 together, one fertile, the other two sterile and reduced to narrow tubular glumes; glumes of the fertile spikelet several-nerved, hyaline below, chartaceous in the upper pointed part, the first glume broad, enfolding the spikelet, the second narrower; sterile lemma similar but a little narrower; fertile lemma and palea hyaline; inflorescence consisting of an ovate, oval, or somewhat cylindrical pearly white or drab bead-like, very hard involucre (much modified sheathing bract) containing the pistillate portion of the inflorescence, the points of the pistillate spikelets and the slender axis of the staminate portion of the inflorescence protruding from the orifice at the apex, the staminate portion as much as 6 cm. long, soon deciduous. Annuals or perennials with branching culms and broad flat blades, the inflorescences numerous on stout peduncles clustered in the axils of the leaves.

TYPE SPECIES: *Coix Lacryma-Jobi* L.

1. **Coix Lacryma-Jobi** L., Sp. Pl. 972. 1753; Hack., Bot. Jahrb. 6: 237. 1885; Hitchc., U. S. Dept. Agric. Misc. Publ. 200: 765. *fig. 1691*. 1935; Pilger, Nat. Pflanzenfam. ed. 2. **14e**: 190. *fig. 103*. 1940. Type from India.

   Coix Lacryma L., Syst. Nat. ed. 10. 1261. 1759 (presumably based on *C. Lacryma-Jobi* L.).

   Coix Lacryma-Jobi L. var. *novoguineensis* Pilger, Bot. Jahrb. 52: 171. 1914. Type from Northeast New Guinea.

Annual; culms erect, stout, much branched upwards, 1–3 meters tall; sheaths glabrous; ligule membranous, ciliate, about 1 mm. long; blades glabrous, narrowly lanceolate, often cordate at base, acute, 10–60 (the lower sometimes to 120) cm. long, 2–5 cm. wide, the margins serrate-scabrous; staminate racemes 1–6 cm. long, glabrous; spikelets 8–10 mm.

long, the first glume winged on the keels; false fruits ovoid-globose, 6–12 mm. long, hard and shiny at maturity.

BRITISH NEW GUINEA: Central Division: Javarie, *White 373* (US). NORTHEAST NEW GUINEA: Madang District: Sepik River, *Herre 322, 335* (NY) (plants 6–8 ft. high, growing in water). NETHERLANDS NEW GUINEA: Arfak Mountains, Female Lake, alt. about 3000 m., *Pratt* in 1908 (US); Nassau Region: Explorat Biv., alt. about 1200 m., *Docters van Leeuwen 10804* (GH). SOLOMON ISLANDS: Bougainville: Kugumaru, alt. 150 m., *Kajewski 1840* (GH) (rainforest; tall grass up to 2 meters tall).

Warmer regions of the world. Sometimes cultivated for the "beads," which are used as ornaments, or for the edible grains.

1a. **Coix Lacryma-Jobi** L. var. **stenocarpa** (Oliver) Stapf in Hook. f., Fl. Brit. Ind. 7: 100. 1897.

Coix Lachryma L. var. *stenocarpa* Oliver, Hook. Ic. 18: *pl. 1764*. 1888. Type from Burma.

Coix stenocarpa (Oliver) Balansa, Jour. de Bot. 4: 77. 1890. Type from Burma.

Coix tubulosa Hack., Bot. Jahrb. 13: 260. 1890. Type from Northeast New Guinea.

Coix Lacryma-Jobi L. var. *tubulosa* (Hack.) K. Schum. in K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 164. 1901.

Differs from the species in having nearly cylindrical rather than ovate or elliptical false fruits. In the specimen cited below the false fruits are about 3.5 mm. in diameter and 10–12 mm. long.

BRITISH NEW GUINEA: Eastern Division: Aisa River, *Brass 1417* (GH) (tall riverbank grass 5–6 ft. tall; fruit glossy, gray).

Indo-Malayan region to New Guinea.

52. Zea L.

Zea L., Sp. Pl. 971. 1753, Gen. Pl. ed. 5. 419. 1754.

Spikelets unisexual; staminate spikelets 2-flowered, in pairs on a rather slender trigonous continuous rachis, one of the pair nearly sessile, the other pediceled; glumes membranous, acute; lemmas and paleas hyaline, the stamens 3; pistillate spikelets 1-flowered, densely crowded in many vertical rows on a cylindrical spongy rachis (cob); glumes broad, rounded or emarginate at apex; lemmas hyaline, the styles filiform, very long and slender, stigmatic nearly to the base. Robust annuals with terminal panicles of staminate racemes and axillary short-peduncled pistillate spikes (ears) enclosed in numerous sheaths (husks), the styles protruding from the end as a mass of silky threads.

TYPE AND ONLY SPECIES: *Zea Mays* L.

1. **Zea Mays** L., Sp. Pl. 971. 1753; Kärnbach, Bot. Jahrb. 16: Beibl. 37: 11. 1892; K. Schum. & Lauterb., Nachtr. Fl. Deutsch. Schutzgeb. Südsee 56. 1905; Pilger, Nat. Pflanzenfam. ed. 2. **14e:** 194–201. *fig. 106*. 1940. Type from America.

Culms erect, robust, more or less succulent, 1–4 meters tall, unbranched, the basal internodes very short, the lower nodes giving rise to adventitious "prop roots"; blades broad and flat, sword-shaped, the midrib prominent.

Widely distributed, in cultivation, in temperate and tropical regions of the world. Known only in cultivation.

Numerous species have been described, but most botanists consider that *Zea* is monotypic but highly variable. No herbarium specimens of this species from New Guinea have been seen, but living plants were

observed in native gardens there by the writer in 1943–44. To what extent this species is cultivated by natives in New Guinea is unknown to me.

DOUBTFUL AND EXCLUDED SPECIES

Andropogon australis Spreng. sensu K. Schum., Notizbl. Bot. Gart. Berlin 1: 207. 1896 = *Sorghum.*

Probably a misidentification of *Sorghum nitidum.*

Andropogon australis Spreng. var. *laeviramis* Hack. apud K. Schum., Bot. Jahrb. 9: 197. 1887.

As far as I can discover, the above is a *nomen nudum.* Schumann and his co-workers used the name on at least three occasions, but a description was never published.

Andropogon halepensis Sibth. var. *propinquus* (Kunth) Hack., Bot. Jahrb. 6: 240. 1885, in Engler, Forschungsreise Gazelle 4(7): 5. 1889.

The above record from the New Guinea region probably represents a misidentification for *Sorghum nitidum.* The latter species is common in the region and is picked up by most collectors. I have seen no specimens of *S. propinquus* from New Guinea. A further reason for believing that the plants were *S. nitidum* is the fact that, although common, *S. nitidum* was not reported by the above authors.

Andropogon Sorghum (L.) Brot. subsp. *halepensis* (L.) Hack. var. *propinquus* (Kunth) Hack. in DC., Monogr. Phan. 6: 503. 1889; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 173. 1901.

See note under *Andropogon halepensis* var. *propinquus.*

Anthistiria ciliata L. f. sensu F. Muell., Pap. Pl. 1: 47. 1876.

According to C. T. White (75, p. 15) the specimen which Mueller cites under this name is *A. imberbis* Retz. = *Themeda triandra* Forsk.

Arthraxon linifolius Henr., Blumea 4: 525. 1941.

No specimens of this nor of the following species were available to me. From Henrard's descriptions they seem to be very close to *A. hispidus.*

Arthraxon pallidus Henr., Blumea 4: 526. 1941.

See comment above.

Chrysopogon Gryllus (L.) Trin. sensu F. M. Bailey, Queensl. Agric. Jour. 23: 220. 1909.

This species has not been reported otherwise from New Guinea. I am not certain which species Bailey had, but it was probably *C. elongatus* or even *C. aciculatus.*

Erianthus pedicellaris (Trin.) Hack. sensu K. Schum., Notizbl. Bot. Gart. Berlin 1: 46. 1895.

This is the only report of this species from the region. Perhaps it represents a misidentification.

Eriochloa punctata (L.) Desv. sensu F. Muell., Pap. Pl. 1: 74. 1876; C. T. White, Proc. Roy. Soc. Queensl. 34: 15. 1923.

Probably the plants referred to this species are *E. procera* (Retz.) C. E. Hubb. I have seen no specimens of *E. punctata* from New Guinea.

Ischaemum aristatum L. var. *arfakense* Rendle in Gibbs, Contr. Phytogr. Fl. Arfak Mt. 89. 1917.

From the description this appears to be merely a synonym of *I. aristatum* L. (sensu meo) as applied to the New Guinea material.

Ischaemum aristatum L. var. *cylindricum* Pilger, Bot. Jahrb. 52: 171. 1914.

Unfortunately no specimens of *I. aristatum* were available from this region (Northeast New Guinea). The description suggests that this variety may be a synonym of *I. aristatum* L. subsp. *barbatum* Hack.

Ischaemum chordatum (Trin.) Hack., Bot. Jahrb. 13: 260. 1890; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 170. 1901.

Spodiopogon chordatum Trin., Mém. Acad. St. Pétersb. VI. 2: 302. 1832. Marianas and Carolines.

From Trinius' rather lengthy description, this species appears to be a synonym of *I. digitatum* Brongn.

Ischaemum rugosum Salisb. sensu Ridley, Trans. Linn. Soc. II. Bot. 9: 249. 1916.

I have seen no specimens nor do I know of any other record of this species from New Guinea. Ridley states that his plant is a dwarf about 15 cm. tall.

Microstegium calochloum (Lauterb. & K. Schum.) Pilger, Nat. Pflanzenfam. ed. 2. 14e: 122. 1940.

Pollinia calochloa Lauterb. & K. Schum. in K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 167. 1901. Type from Northeast New Guinea.

No New Guinea specimens examined match the description precisely, but from the ample description it seems to be only a variety of *Microstegium ciliatum* (Trin.) A. Camus. The ligule is said to be only about 0.5 mm. long, and the rachis joints are completely glabrous. The remainder of the description applies to *Pollinia ciliata* Trin. (sensu Hack. in DC., Monogr. Phan. 6: 176. 1889).

Microstegium glabratum (Brongn.) A. Camus, Ann. Soc. Linn. Lyon 68: 201. 1921; Ohwi, Bot. Mag. (Tokyo) 56: 10. 1942.

Eulalia glabrata Brongn. in Duperry, Bot. Voy. Coquille 93. *pl. 19*. 1831. Type from the Society Islands.

Pollinia glabrata (Brongn.) Trin., Mém. Acad. St. Pétersb. VI. 4: 89. 1836.

From Brongniart's description and figure, this species appears to be closely related to *Microstegium nudum* (Trin.) A. Camus, and I suspect it may be a synonym. The two species follow one another in Hackel's Monograph, and the distinctions separating them in that work seem very slight.

Panicum brevifolium L. sensu F. Muell., Pap. Pl. 2: 19. 1855.

This species was reported from New Guinea only by F. von Mueller in 1885. I have seen no reports from New Guinea since that date and suspect that it was probably a misidentification. Perhaps Mueller's plant was *Cyrtococcum patens* (L.) A. Camus, as that species bears a superficial resemblance to *Panicum brevifolium*.

Panicum filiforme L. sensu K. Schum., Notizbl. Bot. Gart. Berlin 1: 208. 1896 = *Digitaria filiformis* (L.) Koel.

This species was originally described from North America. I know of no other record of this plant from the New Guinea area. Perhaps Schumann's plant was *D. violascens* Link, which is common in the region. It is listed by Schumann as being a common weed of cultivated ground.

Panicum foliosum R. Br. sensu K. Schum., Bot. Jahrb. 9: 196. 1887 = *Brachiaria foliosa* (R. Br.) Hughes.

Reported from Finschhafen by Schumann. I know of no other record. It seems somewhat unlikely that this Australian species should occur in Northeast New Guinea and yet not be represented in the numerous collections which have been made on the Australian side of British New Guinea. Perhaps this represents a misidentification of *Brachiaria subquadripara* (Trin.) Hitchc.

Panicum interruptum Willd. sensu Ridley, Trans. Linn. Soc. II. Bot. 9: 248. 1916.

From a fragment of the type specimen (at US), consisting of two somewhat crushed spikelets, this species seems referable to *Sacciolepis*. This is the only report of the species from New Guinea known to me.

Panicum javanicum Poir. sensu Burkill, Proc. Camb. Phil. Soc. 9: 93. 1896; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 177. 1901.

The original description is too inadequate to permit positive identification. Trinius (Mém. Acad. St. Pétersb. VI. 3: 243. 1834) lists *Urochloa panicoides* Beauv. as a synonym. Hooker f. (Fl. Brit. Ind. 7: 36. 1896), in a note under *P. javanicum*, states: "Kunth (Revis. Gram. i. 206) says, under *Urochloa panicoides*, that he has examined in Desfontaine's Herbarium the type of Poiret's *P. javanicum*, and identified it, which he cites as a syn. of *Urochloa panicoides*, but his figure of which again quite accords with a narrow-leaved form of *P. Helopus*, Trin. This requires the adoption [of] the name *javanicum* (by misprint *japonicum* in Kunth Revis.), for the species. Bentham, on the other hand (Fl. Austral. vii. 477), says that Munro has seen an authentic specimen of *javanicum*, and that it is quite distinct from *P. Helopus*. I have no means of verifying either authority."

Hitchcock (Jour. Wash. Acad. Sci. 9: 551. 1919) confidently states that *P. javanicum* Poir. is a synonym of *Panicum panicoides* (Beauv.) Hitchc. (*Urochloa panicoides* Beauv.). He states that since *P. javanicum* Poir. is described as having glabrous spikelets, and Beauvois' figure of *Urochloa panicoides* accompanying the original description shows the spikelets to be glabrous, they are synonyms. He further states that *P. Helopus* has pubescent spikelets and is thus excluded from consideration. It is interesting to note that all the specimens in the U.S. National Herbarium which have been labeled *P. javanicum* are from India — none are from Java. This leaves some doubt, I think, as to the identity of *P. javanicum*. Since C. E. Hubbard & Vaughan (39, p. 74) state under *Urochloa panicoides* that specimens of this species have been referred to *Panicum javanicum* Poir., it seems apparent that these authors do not agree with Hitchcock's interpretation.

Panicum multinode Lam. sensu F. Muell., Pap. Pl. 1: 31. 1876.

Mueller states that this seems referable to *P. repens* L. I have seen no specimens of this latter species from New Guinea. *Panicum multinode* Lam. is referable to the genus *Cyrtococcum*, which bears little resemblance to *Panicum repens*. Without seeing the actual specimens (of which none are cited by Mueller) it is impossible to determine to what species Mueller's report applies.

Panicum papuanum Mez, Bot. Jahrb. 56: Beibl. 125: 5. 1921.

Mez' original description is brief and quite inadequate. He states merely "Laminae anguste lineares. Nodi glabri. Inflorescentia laxe 3-pinnata. Spiculae quam pedicelli gracillimi breviores, glabrae, ellipticae, acutae, 2 mm. longae. Glumae I., II. = 7-, III. = 9-nervia. Flos inferior abortivus palea minuta. Palea floris herm. stramineae, politissimae." The specimen questionably referred to this species by Chase (17, p. 309) is *Panicum mindanaense* Merr. In that specimen both glumes and the sterile lemma are 5-nerved.

Panicum parviflorum R. Br. sensu K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee 177. 1901 = *Digitaria parviflora* (R. Br.) Hughes.

This Australian species is reported from New Guinea only in Schumann's publications and probably represents a misidentification of another species such as *D. violascens*.

Panicum plicatum Lam. sensu F. Muell., Vict. Nat. 2: 20. 1855; Ridley, Trans. Linn. Soc. Bot. 9: 248. 1916; C. T. White, Proc. Roy. Soc. Queensl. 34: 16. 1923.

This is probably the species which I am calling *Setaria palmaefolia*. *Setaria plicata* (Lam.) T. Cooke is considered to be distinct by some authors, but the differences seem slight. I am not citing it as a synonym of *S. palmaefolia* pending further study.

Panicum trachyrachis Benth. sensu Hack., Bot. Jahrb. 13: 258. 1890; K. Schum., Notizbl. Bot. Gart. Berlin 2: 92. 1898.

An Australian species related to *P. virgatum* L. Reported by the German workers from Northeast New Guinea and the Bismarck Archipelago. The species may well occur in New Guinea, but I have seen no specimens.

Panicum virgatum L. sensu F. Muell., Pap. Pl. 1: 47. 1876; F. M. Bailey, Queensl. Agric. Jour. 9: 411. 1901.

This is the species which Bentham calls *P. trachyrachis* Benth. (See note under that species.)

Paspalum foliosum (R. Br.) K. Schum. & Hollr., Fl. Kais. Wilhelmsland 21. 1889.

Obviously an error for *Panicum foliosum* R. Br. = *Digitaria foliosa* (R. Br.) Hughes.

Paspalum miliare (Lam.) K. Schum. & Hollr., Fl. Kais. Wilhelmsland 21. 1889.

An error for *Panicum miliare* Lam. In K. Schum. & Lauterb. (69, p. 179), *P. miliare* sensu K. Schum. in Fl. Kais. Wilhelmsland (non Lam.) is listed as a synonym under *Panicum caesium* Nees = *P. cambogiense* Balansa.

Paspalum parviflorum (R. Br.) K. Schum. & Hollr., Fl. Kais. Wilhelmsland 21. 1889 = *Digitaria parviflora* (R. Br.) Hughes.

Obviously an error in copying *Panicum parviflorum*. See note under that species.

Pennisetum cenchroides (L.) Rich. sensu F. M. Bailey, Queensl. Agric. Jour. 23: 220. 1909 = *Pennisetum ciliare* (L.) Link.

This species occurs in Australia and, although I have seen no specimens, perhaps also in New Guinea. The above is the only record from New

Guinea known to me. C. T. White (75, p. 16) says Bailey's plant is *Cenchrus echinatus* L.

Rottboellia brevis Chauvin ex Steud., Syn. Pl. Glum. 1: 361. 1854.

This species was described from a specimen collected on the island of Waigiou. Hackel (23, p. 313) lists it under "species inextricabilis." I have no further information.

Rottboellia Coelorachis Forst. sensu Hack. in Engler, Forschungsreise Gazelle 4(7): 4. 1889.

According to Hackel (23, p. 294) and Pilger (59, p. 138) this is a distinct species from *R. exaltata*. I have seen no specimens which I could segregate.

Setaria aurea Hochst. sensu Hack., Denkschr. Akad. Wiss. Math.-Naturw. (Wien) 89: 495. 1913.

This is apparently the species which I am calling *Setaria pallide-fusca* (Schum.) Stapf & Hubb., as there are some sheets in the U.S. National Herbarium labeled *S. aurea* which seem to be *S. pallide-fusca*.

Setaria verticillata (L.) Beauv. sensu K. Schum., Notizbl. Bot. Gart. Berlin 2: 94. 1898.

The above is the only report of this species from the New Guinea region known to me. It may well occur there, but I have seen no specimens.

Stenotaphrum subulatum Trin. sensu Hack., Bot. Jahrb. 6: 237. 1885; F. Muell., Pap. Pl. 6: 19. 1885; K. Schum., Bot. Jahrb. 9: 196. 1887.

The above reports were all based on a single collection. No other report of this species from New Guinea is known to me. It is perhaps a misidentification or the locality of the specimen may be erroneous.

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LIST OF CITED SPECIMENS

Armit, W. 44. *Themeda gigantea* var. *novoguineensis;* 55. *Imperata exaltata.*

Arnot, W. E. 38. *Digitaria Baileyi.*

Baim, T. C.—. *Pogonatherum paniceum* (March 12, 1943).

Bauerlen, W. 40. *Echinochloa colonum;* 43. *Pogonatherum paniceum;* 60. *Erianthus arundinaceus;* 61. *Panicum cambogiense.*

Bradthe, W. 5. *Polytoca macrophylla.*

Brass, L. J. 514. *Ischaemum muticum;* 521. *Paspalum longifolium;* 522. *Apluda mutica;* 538. *Pennisetum macrostachyum;* 634. *Themeda gigantea* var. *amboinensis;* 765. *Themeda triandra;* 768. *Pogonatherum paniceum;* 776. *Rottboellia rottboellioides;* 920. *Miscanthus floridulus;* 1018. *Isachne Brassii;* 1177. *Ischaemum muticum;* 1183. *Paspalum scrobiculatum;* 1203. *Polytoca macrophylla;* 1205. *Themeda gigantea* var. *amboinensis;* 1213. *Ischaemum digitatum* var. *polystachyum;* 1229. *Paspalum vaginatum;* 1391. *Pogonatherum paniceum;* 1397. *Elyonurus citreus;* 1417. *Coix Lacryma-Jobi* var. *stenocarpa;* 1423. *Cyrtococcum oxyphyllum;* 1534. *Oplismenus hirtellus;*

1616. *Ischaemum muticum;* 2551. *Themeda triandra;* 2593. *Ischaemum littorale;* 2629. *Polytoca macrophylla;* 2646. *Ischaemum muticum;* 2732. *Cyrtococcum oxyphyllum;* 2813bis. *Ischaemum littorale;* 2817. *Paspalum conjugatum;* 2841. *Paspalum orbiculare;* 2857. *Themeda gigantea* var. *amboinensis;* 2857A. *Cyrtococcum oxyphyllum;* 2893. *Pogonatherum paniceum;* 3070. *Thuarea involuta;* 3126. *Themeda gigantea* var. *amboinensis;* 3241. *Themeda triandra;* 3386. *Pogonatherum paniceum;* 3405. *Isachne Schmidtii;* 3518. *Themeda gigantea;* 3558. *Andropogon micranthus;* 3586. *Ophiuros exaltatus;* 3589. *Themeda gigantea* var. *novoguineensis;* 3610. *Pennisetum macrostachyum;* 3613. *Apluda mutica;* 3617. *Polytoca macrophylla;* 3628. *Saccharum spontaneum;* 3629. *Sorghum nitidum;* 3631. *Panicum viale;* 3632. *Heteropogon contortus;* 3639. *Brachiaria fusiformis;* 3647. *Oplismenus hirtellus;* 3692. *Themeda triandra;* 3701. *Hackelochloa granularis;* 3702. *Rottboellia rottboellioides;* 3710. *Themeda gigantea* var. *novoguineensis;* 3713. *Cymbopogon procerus;* 3723. *Themeda triandra;* 3724. *Ophiuros exaltatus;* 3820. *Cyrtococcum oxyphyllum;* 3935. *Paspalum conjugatum;* 4132. *Isachne villosa;* 4191. *Miscanthus floridulus;* 4528. *Miscanthus floridulus;* 4642. *Isachne Myosotis;* 4721. *Imperata exaltata* subsp. *Merrillii;* 4723. *Miscanthus floridulus;* 4778. *Miscanthus floridulus;* 4787. *Arthraxon hispidus;* 4788. *Setaria montana;* 4789. *Sacciolepis indica;* 4792. *Setaria palmaefolia;* 4799. *Andropogon micranthus;* 4802. *Dimeria dipteros;* 4807. *Isachne globosa;* 4808. *Ischaemum digitatum* var. *polystachyum;* 4813. *Imperata exaltata;* 4817. *Hyparrhenia bracteata;* 4871. *Isachne arfakensis;* 5208. *Panicum sarmentosum;* 5270. *Pogonatherum paniceum;* 5310. *Rottboellia rottboellioides;* 5403. *Apluda mutica;* 5482. *Setaria pallide-fusca;* 5483. *Sacciolepis indica;* 5485. *Polytoca macrophylla;* 5513. *Pennisetum macrostachyum;* 5522. *Digitaria pruriens;* 5532. *Ischaemum digitatum* var. *polystachyum;* 5594. *Cyrtococcum oxyphyllum;* 5617. *Cyrtococcum patens;* 5710. *Eulalia trispicata;* 5725. *Cymbopogon procerus;* 5726. *Ischaemum aristatum;* 5727. *Germainia capitata;* 5733. *Eulalia irritans;* 5735. *Ophiuros exaltatus;* 5740. *Setaria pallide-fusca;* 5743. *Eremochloa bimaculata;* 5744. *Sacciolepis indica;* 5745. *Alloteropsis semialata;* 5827. *Sacciolepis indica;* 5828. *Panicum distans;* 5854. *Isachne confusa;* 5873. *Themeda triandra;* 5895. *Sorghum nitidum;* 5910. *Brachiaria holosericea;* 5911. *Dimeria ciliata;* 5922. *Paspalum longifolium;* 5923. *Panicum Archboldii;* 5926. *Eulalia trispicata;* 5927. *Themeda triandra;* 5928. *Ischaemum aristatum* subsp. *barbatum;* 5957. *Apluda mutica;* 5960. *Panicum mindanaense;* 5961. *Ischaemum fragile;* 5984. *Dimeria glabriuscula;* 5985. *Andropogon brevifolius;* 6001. *Hemarthria subulata;* 6014. *Thaumastochloa rariflora;* 6029. *Sacciolepis myosuroides;* 6040. *Ischaemum aristatum* subsp. *barbatum;* 6044. *Echinochloa colonum;* 6045. *Chrysopogon elongatus;* 6060. *Echinochloa crusgalli;* 6252. *Sorghum nitidum;* 6253. *Ischaemum aristatum* subsp. *barbatum;* 6254. *Rottboellia rottboellioides;* 6260. *Panicum nodosum;* 6269. *Themeda triandra;* 6270. *Setaria pallide-fusca;* 6283. *Chrysopogon elongatus;* 6285. *Paspalum vaginatum;* 6295. *Cyrtococcum patens;* 6296. *Rottboellia exaltata;* 6297. *Paspalum scrobiculatum;* 6300. *Echinochloa colonum;* 6301. *Brachiaria subquadripara;* 6303. *Panicum reptans;* 6305. *Digitaria pruriens;* 6339. *Ischaemum digitatum;* 6341. *Paspalum longifolium;* 6342. *Panicum Archboldii;* 6343. *Alloteropsis semialata;* 6350. *Panicum macrocladum;* 6364. *Cymbopogon procerus;* 6382. *Themeda gigantea* var. *amboinensis;* 6387. *Panicum distans;* 6395. *Cenchrus Brownii;* 6397. *Pennisetum macrostachyum;* 6404. *Andropogon annulatus;* 6408. *Paspalum vaginatum;* 6410. *Ischaemum muticum;* 6426. *Chrysopogon aciculatus;* 6431. *Apluda mutica;* 6474. *Themeda frondosa;* 6484. *Panicum Archboldii;* 6485. *Panicum mindanaense;* 6486. *Ischaemum fragile;* 6524. *Eulalia irritans;* 6537. *Ophiuros exaltatus;* 6538. *Heteropogon triticeus;* 6554. *Thaumastochloa rariflora;* 6555. *Germainia capitata;* 6568. *Panicum macrocladum;* 6582. *Erianthus arundinaceus;* 6585. *Echinochloa stagnina;* 6810. *Pogonatherum paniceum;* 6945. *Imperata exaltata;* 6948. *Paspalum scrobiculatum;* 6957. *Saccharum spontaneum;* 6961. *Sacciolepis indica;* 7364. *Isachne Brassii;* 7483. *Oplismenus hirtellus;* 7519. *Sacciolepis indica;* 7522. *Panicum mindanaense;* 7528. *Ischaemum digitatum;* 7529. *Paspalum scrobiculatum;* 7552. *Hemarthria subulata;* 7600. *Pseudoraphis squarrosa;* 7602. *Isachne*

globosa; 7613. *Hymenachne amplexicaulis;* 7643. *Ophiuros exaltatus;* 7644. *Sorghum nitidum;* 7645. *Eulalia irritans;* 7647. *Panicum paludosum;* 7768. *Themeda gigantea* var. *amboinensis;* 7771. *Apluda mutica;* 7773. *Cyrtococcum patens;* 7806. *Dimeria monostachya;* 7807. *Dimeria ciliata* var. *heteromorpha;* 7808. *Eremochloa ciliaris* var. *elata;* 7809. *Eulalia trispicata;* 7810. *Brachiaria holosericea;* 7812. *Andropogon brevifolius;* 7832. *Isachne confusa;* 7849. *Eremochloa ciliaris* var. *elata;* 7850. *Dimeria glabriuscula;* 7851. *Panicum mindanaense;* 7852. *Panicum mindanaense;* 7854. *Sacciolepis myosuroides;* 7874. *Ischaemum fragile;* 7880. *Sacciolepis indica;* 7883. *Setaria pallide-fusca;* 7889. *Cyrtococcum patens;* 7900. *Ischaemum aristatum;* 7920. *Elyonurus citreus;* 7924. *Alloteropsis semialata;* 7932. *Dimeria ciliata* var. *heteromorpha;* 7933. *Andropogon sanguineus;* 7934. *Ischaemum fragile;* 7950. *Eulalia trispicata;* 7957. *Panicum sarmentosum;* 8220. *Pogonatherum paniceum;* 8251. *Eulalia irritans;* 8254. *Rottboellia rottboellioides;* 8259. *Ischaemum aristatum;* 8260. *Ischaemum aristatum* subsp. *barbatum;* 8263. *Sorghum nitidum;* 8279. *Eulalia trispicata;* 8280. *Echinochloa crusgalli;* 8296. *Imperata cylindrica* var. *major;* 8302. *Paspalum scrobiculatum;* 8324. *Digitaria radicosa;* 8325. *Paspalum conjugatum;* 8343. *Panicum distans;* 8351. *Sacciolepis indica;* 8370. *Cymbopogon procerus;* 8408. *Eremochloa bimaculata;* 8409. *Alloteropsis semialata;* 8460. *Chrysopogon filipes* var. *arundinaceus;* 8470. *Pseudoraphis squarrosa;* 8537. *Sclerandrium truncatiglume;* 8566. *Eulalia trispicata;* 8567. *Sorghum nitidum;* 8579. *Chrysopogon elongatus;* 8637. *Germainia capitata;* 8654. *Panicum marginatum;* 8665. *Sclerandrium truncatiglume;* 8695. *Digitaria Baileyi;* 8696. *Panicum distans;* 8697. *Eulalia trispicata;* 8713. *Sacciolepis indica;* 8735. *Cleistochloa Sclerachne;* 8751. *Ischaemum aristatum;* 8776. *Sacciolepis indica;* 8782. *Themeda gigantea* var. *novoguineensis;* 8787. *Andropogon annulatus;* 8815. *Ischaemum aristatum* subsp. *barbatum;* 8893. *Pennisetum macrostachyum;* 8909. *Ichnanthus vicinus;* 8920. *Saccharum spontaneum;* 9556. *Isachne Myosotis;* 10235. *Imperata exaltata* subsp. *Merrillii* [with E. Meyer-Drees]; 10704. *Isachne Myosotis;* 10735. *Arthraxon hispidus;* 10736. *Sacciolepis indica;* 10743. *Isachne globosa;* 10746. *Setaria montana;* 10901. *Eulalia leptostachys;* 10902. *Imperata exaltata* subsp. *Merrillii;* 11363. *Eulalia leptostachys;* 11374. *Saccharum spontaneum;* 11385. *Ischaemum digitatum;* 11471. *Setaria palmaefolia;* 11488. *Setaria montana;* 11491. *Imperata exaltata* subsp. *Merrillii;* 11524. *Sacciolepis indica;* 11542. *Isachne globosa;* 11559. *Isachne albens;* 11568. *Pogonatherum paniceum;* 11583. *Isachne Myosotis;* 11584. *Miscanthus floridulus;* 11616. *Andropogon spicigerus;* 11617. *Ischaemum pubescens;* 11618. *Sorghum nitidum;* 11631. *Pogonatherum paniceum;* 11678. *Themeda gigantea* var. *amboinensis;* 11722. *Germainia capitata;* 11723. *Andropogon brevifolius;* 11732. *Ischaemum pubescens;* 11738. *Dimeria dipteros;* 11777. *Pennisetum macrostachyum;* 11778. *Saccharum spontaneum;* 11793. *Echinochloa crusgalli;* 11798. *Apluda mutica;* 11803. *Echinochloa crusgalli;* 11805. *Andropogon spicigerus;* 11806. *Ischaemum digitatum;* 11809. *Miscanthus floridulus;* 11813. *Digitaria radicosa;* 11814. *Setaria montana* [specimen at A]; 11814. *Setaria pallide-fusca* [specimen at US]; 11817. *Paspalum scrobiculatum;* 11822. *Digitaria violascens;* 11823. *Isachne globosa;* 11824. *Sacciolepis indica;* 11825. *Eulalia leptostachys;* 11845. *Andropogon spicigerus;* 12364. *Oplismenus hirtellus;* 12370. *Isachne villosa;* 12475. *Isachne villosa;* 13201. *Isachne Myosotis;* 13210. *Ichnanthus vicinus;* 13263. *Setaria palmaefolia;* 13264. *Saccharum spontaneum;* 13479. *Pogonatherum paniceum;* 13719. *Oplismenus hirtellus;* 13720. *Microstegium spectabile;* 13721. *Ischaemum digitatum* var. *polystachyum;* 13784. *Paspalum scrobiculatum;* 13785. *Echinochloa stagnina;* 13791. *Saccharum spontaneum;* 13942. *Panicum auritum;* 13946. *Panicum zizanioides;* 14055. *Isachne Brassii.*

Britton, M. E. 22. *Setaria italica.*

Burcham, L. T. 119. *Apluda mutica;* 120. *Digitaria pruriens;* 121. *Sorghum nitidum;* 122. *Paspalum scrobiculatum* var. *bispicatum;* 124. *Rottboellia rottboellioides;* 125. *Setaria pallide-fusca;* 126. *Polytoca macrophylla;* 128. *Panicum nodosum;* 129. *Paspalum scrobiculatum;* 130. *Paspalum orbiculare;* 131. *Alloteropsis semialata;* 133. *Setaria palmaefolia;* 134. *Paspalum paniculatum;* 135. *Cyrtococcum patens;* 136. *Chrysopogon aciculatus;* 137. *Oplismenus compositus;* 138. *Oplismenus hirtellus;*

139. *Cyrtococcum oxyphyllum;* 140. *Ischaemum digitatum* var. *polystachyum;* 141. *Andropogon micranthus.*

CARR, C. E. 11022. *Echinochloa colonum;* 11025. *Paspalum conjugatum;* 11031. *Digitaria pruriens;* 11032. *Panicum nodosum;* 11033. *Chrysopogon aciculatus;* 11048. *Panicum viale;* 11054. *Alloteropsis semialata;* 11091. *Panicum reptans;* 11104. *Panicum viale;* 11106. *Andropogon micranthus* var. *muticispiculus;* 11108. *Digitaria abortiva;* 11111. *Sorghum nitidum;* 11129. *Saccharum spontaneum;* 11133. *Themeda triandra;* 11134. *Ophiuros exaltatus;* 11135. *Sorghum nitidum;* 11180. *Cenchrus echinatus;* 11235. *Themeda gigantea* var. *novoguineensis;* 11244. *Imperata exaltata;* 11309. *Andropogon micranthus* var. *muticispiculus;* 11329. *Andropogon intermedius;* 11344. *Polytoca macrophylla;* 11345. *Pogonatherum paniceum;* 11355. *Setaria palmaefolia;* 11382. *Setaria surgens;* 11398. *Brachiaria subquadripara* var. *piligera;* 11413. *Ischaemum muticum;* 11417. *Thuarea involuta;* 11435. *Eriochloa procera;* 11439. *Digitaria sanguinalis;* 11440. *Digitaria pruriens;* 11445. *Spinifex littoreus* var. *longifolius;* 11503. *Cyrtococcum patens* var. *Warburgii;* 11546. *Alloteropsis semialata;* 11622. *Panicum creperum;* 11658. *Pennisetum macrostachyum;* 11736. *Ischaemum digitatum;* 11741. *Apluda mutica;* 11771. *Cyrtococcum oxyphyllum;* 11786. *Cyrtococcum oxyphyllum;* 11964. *Cyrtococcum trigonum;* 12236. *Microstegium spectabile;* 12362. *Isachne pauciflora;* 12412. *Isachne Myosotis;* 12525. *Panicum sarmentosum;* 12941. *Cyrtococcum oxyphyllum;* 12971. *Isachne Myosotis;* 14271. *Isachne villosa.*

CHALMERS, REV. J. 42. *Panicum sarmentosum;* 59. *Cyrtococcum oxyphyllum;* 71. *Eulalia irritans;* 72. *Panicum sarmentosum.*

CLEMENS, M. S. 34. *Sorghum laxiflorum;* 312. *Isachne Myosotis;* 1410. *Saccharum spontaneum;* 4053. *Sacciolepis indica;* 4105. *Isachne albens;* 4280. *Panicum ambiguum;* 4303. *Panicum sarmentosum;* 4307. *Hackelochloa granularis;* 4315. *Sacciolepis indica;* 4332. *Ichnanthus vicinus;* 4454. *Miscanthus floridulus;* 4498. *Setaria montana;* 4592. *Isachne albens;* 4725. *Eulalia leptostachys;* 4775. *Echinochloa crusgalli;* 4860. *Isachne villosa;* 4956. *Isachne villosa;* 5409. *Isachne albens;* 5476. *Echinochloa crusgalli;* 5756. *Oplismenus hirtellus;* 5856. *Isachne villosa;* 5924. *Isachne villosa;* 6097. *Isachne Myosotis;* 6120. *Digitaria perpusilla;* 6145. *Miscanthus floridulus;* 6548a. *Pogonatherum paniceum;* 6558. *Saccharum spontaneum;* 6958a. *Isachne albens;* 9209. *Isachne arfakensis;* 9239. *Isachne albens;* 10279. *Microstegium nudum;* 10359. *Digitaria violascens;* 10379. *Isachne albens;* 10441. *Sorghum laxiflorum;* 10458. *Andropogon micranthus;* 10459bis. *Alloteropsis semialata;* 10475. *Panicum reptans;* 10476-s. *Echinochloa colonum;* 10477. *Andropogon brevifolius;* 10515. *Heteropogon contortus;* 10540J. *Setaria pallide-fusca;* 10541. *Andropogon micranthus* var. *muticispiculus;* 10541bis. *Andropogon micranthus;* 10552. *Pogonatherum paniceum;* 10552A. *Polytoca macrophylla;* 10568. *Oplismenus compositus;* 10630. *Digitaria pruriens;* 10631. *Apluda mutica;* 10650. *Echinochloa crusgalli;* 10665. *Sorghum nitidum;* 10668b. *Imperata cylindrica* var. *major;* 10696. *Panicum paludosum;* 10706. *Paspalum longifolium;* 10713e. *Heteropogon contortus;* 10857. *Eulalia leptostachys;* 10955bis. *Sacciolepis indica;* 10980. *Sorghum laxiflorum;* 11047. *Paspalum orbiculare;* 11272. *Cyrtococcum patens;* 40782. *Hackelochloa granularis;* 40793. *Pennisetum macrostachyum;* 40838. *Ophiuros exaltatus;* 40867. *Hackelochloa granularis;* 40885. *Isachne Myosotis;* 41090. *Sorghum laxiflorum;* 41172. *Pennisetum macrostachyum;* 41238. *Ichnanthus vicinus;* 41356a. *Sacciolepis indica* mixed with *S. myosuroides;* 41608. *Polytoca macrophylla;* 41714. *Isachne villosa;* 41715. *Microstegium spectabile;* 41808. *Ichnanthus vicinus;* —. *Isachne Brassii* (October 20, 1940); —. *Brachiaria coccosperma* (February 21, 1940).

DOCTERS VAN LEEUWEN, W. M. 9252. *Paspalum conjugatum;* 9709. *Echinochloa crusgalli;* 9727. *Pennisetum macrostachyum;* 10167. *Echinochloa crusgalli;* 10498. *Digitaria radicosa;* 10500. *Imperata exaltata;* 10787. *Isachne Myosotis;* 10804. *Coix Lacryma-Jobi;* 10809. *Sacciolepis indica;* 10814. *Setaria palmaefolia;* 11149. *Hymenachne amplexicaulis;* 11368. *Polytoca macrophylla.*

HARTMAN, E. 73. *Panicum sarmentosum.*

HERRE, A. W. 132. *Pennisetum macrostachyum;* 185. *Ischaemum muticum;* 198. *Polytoca macrophylla;* 231. *Imperata exaltata;* 284. *Saccharum spontaneum;* 313. *Setaria palmaefolia;* 319. *Echinochloa stagnina;* 322. *Coix Lacryma-Jobi;* 335. *Coix Lacryma-Jobi.*

HOMBRON, J. B. 1841. *Panicum ambiguum.*

JESWIET, J. —. *Saccharum spontaneum* (June, 1928); —. *Saccharum spontaneum* (July, 1928).

KAJEWSKI, S. F. 1779. *Setaria palmaefolia;* 1840. *Coix Lacryma-Jobi;* 1897. *Panicum cambogiense;* 1989. *Polytoca macrophylla;* 2139. *Cyrtococcum oxyphyllum;* 2245. *Pennisetum macrostachyum;* 2253. *Cyrtococcum patens.*

KANEHIRA, R., & S. HATUSIMA. 13093. *Panicum mindanaense* var. *villosa;* 13160. *Oplismenus hirtellus;* 13243. *Microstegium ciliatum* var. *laxum;* 13291. *Erianthus fastigiatus;* 13371. *Setaria pallide-fusca;* 13390. *Andropogon brevifolius* var. *cryptopodus;* 13588. *Isachne arfakensis;* 13826. *Sacciolepis indica;* 14019. *Isachne albens;* 14144. *Brachiaria subquadripara;* 14221. *Isachne Brassii.*

KING, REV. COPELAND. 1018. *Apluda mutica;* —. *Panicum cambogiense* (in 1912).

KLOSS, C. B.—. *Sacciolepis indica* (Jan. 1913).

LAUTERBACH, K. 24. *Pennisetum macrostachyum.*

LEDERMANN, C. 10444. *Isachne Brassii.*

MACFARLANE, S. 48. *Apluda mutica.*

MACGREGOR, Sir WILLIAM. 7. *Germainia capitata;* 8. *Eulalia irritans* var. *egregia;* 10. *Andropogon micranthus;* 11. *Setaria surgens;* 12. *Panicum sarmentosum;* 13. *Setaria surgens;* 14. *Echinochloa crusgalli;* 18. *Panicum macrocladum;* 19. *Rottboellia rottboellioides;* 20. *Andropogon micranthus;* 21. *Panicum viale;* 37. *Alloteropsis semialata;* 41. *Panicum sarmentosum;* 46. *Chrysopogon elongatus;* 50. *Isachne villosa;* 52. *Andropogon micranthus* var. *muticispiculus;* 53. *Eulalia irritans;* —. *Cenchrus Brownii* (in 1889).

NAUMANN, C. —. *Pennisetum macrostachyum* (Aug. 8, 1875).

PARKINSON, R. 45. *Sorghum nitidum;* 47. *Ischaemum muticum;* 64. *Themeda gigantea* var. *amboinensis;* 65. *Imperata exaltata;* 66. *Digitaria pruriens.*

PEEKEL, G. 301. *Digitaria longissima.*

PRATT, A. E. —. *Coix Lacryma-Jobi* (Dec. 1908).

REEDER, J. R. 799. *Paspalum conjugatum;* 801. *Andropogon micranthus* var. *muticispiculus;* 802. *Alloteropsis semialata;* 803. *Themeda triandra;* 804. *Setaria pallide-fusca;* 805. *Paspalum paniculatum;* 806. *Hackelochloa granularis;* 808. *Sorghum nitidum;* 809. *Rottboellia rottboellioides* [specimen at A]; 809. *Ophiuros exaltatus* [specimen at US]; 810. *Andropogon micranthus* var. *muticispiculus;* 811. *Digitaria longiflora;* 812. *Chrysopogon aciculatus;* 813. *Imperata exaltata;* 815. *Paspalum scrobiculatum* var. *bispicatum;* 817. *Digitaria radicosa;* 818. *Paspalum scrobiculatum;* 819. *Apluda mutica;* 820. *Cyrtococcum oxyphyllum;* 821. *Eulalia trispicata;* 822. *Sorghum laxiflorum;* 823. *Sacciolepis indica;* 824. *Cyrtococcum patens;* 825. *Sacciolepis indica;* 826. *Paspalum scrobiculatum;* 828. *Saccharum spontaneum;* 829. *Digitaria pruriens;* 833. *Digitaria violascens;* 841. *Brachiaria subquadripara;* 842. *Polytoca macrophylla;* 845. *Ischaemum digitatum* var. *polystachyum;* 847. *Sacciolepis indica;* 849. *Andropogon brevifolius* var. *paradoxus;* 855. *Setaria pallide-fusca;* 868. *Oplismenus hirtellus;* 885. *Setaria palmaefolia;* 886. *Pogonatherum paniceum;* 904. *Panicum cambogiense;* 905. *Panicum mindanaense.*

RODATZ & KLINK. 69. *Oplismenus compositus.*

ROGERS, H. J. 3001. *Imperata cylindrica* var. *major;* 3003. *Andropogon micranthus* var. *muticispiculus;* 3004. *Themeda triandra.*

RUSSELL, DEKALB, Jr. —. *Oplismenus compositus* (May 23, 1943).

SAWYER, F. E. 32. *Echinochloa colonum;* 34. *Paspalum conjugatum;* 51. *Rottboellia rottboellioides;* 52. *Echinochloa colonum;* 81. *Imperata cylindrica* var. *major;* 82. *Cenchrus echinatus;* 83. *Digitaria sanguinalis;* 91. *Panicum reptans;* 92. *Digitaria sanguinalis;* 93. *Paspalum orbiculare;* 94. *Paspalum scrobiculatum;* 108. *Paspalum conjugatum;* 143. *Sacciolepis indica;* 144. *Chrysopogon aciculatus;* 163. *Chrysopogon aciculatus.*

SAWYER, W. S. 76. *Eulalia leptostachys.*

SIGAFOOS, R. 28. *Themeda triandra;* 68. *Sorghum nitidum.*

SMITH, L. S. 98 (N. G.). *Eulalia trispicata.*

TURNER, L. —. *Ischaemum Turneri.*

WARBURG, O. 20968. *Apluda mutica.*

WEINLAND, C. A. F. 75. *Digitaria pruriens;* 266. *Ophiuros exaltatus;* 276. *Cyrtococcum patens;* 278. *Cyrtococcum oxyphyllum;* 279. *Oplismenus compositus;* 281. *Sorghum nitidum;* 290. *Apluda mutica;* 347. *Ischaemum muticum;* 357. *Setaria pallide-fusca;* —. *Panicum reptans* (in 1889–91).

WHITE, C. T. 30. *Apluda mutica;* 373. *Coix Lacryma-Jobi.*

ZAHN, H. —. *Imperata cylindrica* var. *major.*

EXPLANATION OF PLATES

All figures are drawn from types.

PLATE V

Dimeria monostachya Reeder (*Brass 7806*): a. habit, × ½; b. spikelet, × 10.

Hemarthria subulata Reeder (*Brass 6001*): c. inflorescence, × ½; d. & e. two views of lower spikelet attached to the rachis joint, × 10.

PLATE VI

Dimeria dipteros Reeder (*Brass 11738*): a. habit, × ½; b. spikelet, × 10.

PLATE VII

Ischaemum littorale Reeder (*Brass 2593*): a. habit, × ½; b. pair of spikelets attached to the rachis joint; c. dorsal view of first glume of the lower spikelet (b & c, × 10).

Eulalia irritans (R. Br.) Kuntze var. *egregia* Reeder (*MacGregor 8*): d & e. two views of spikelet, × 10.

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GRAMINEAE-PANICOIDEAE OF NEW GUINEA

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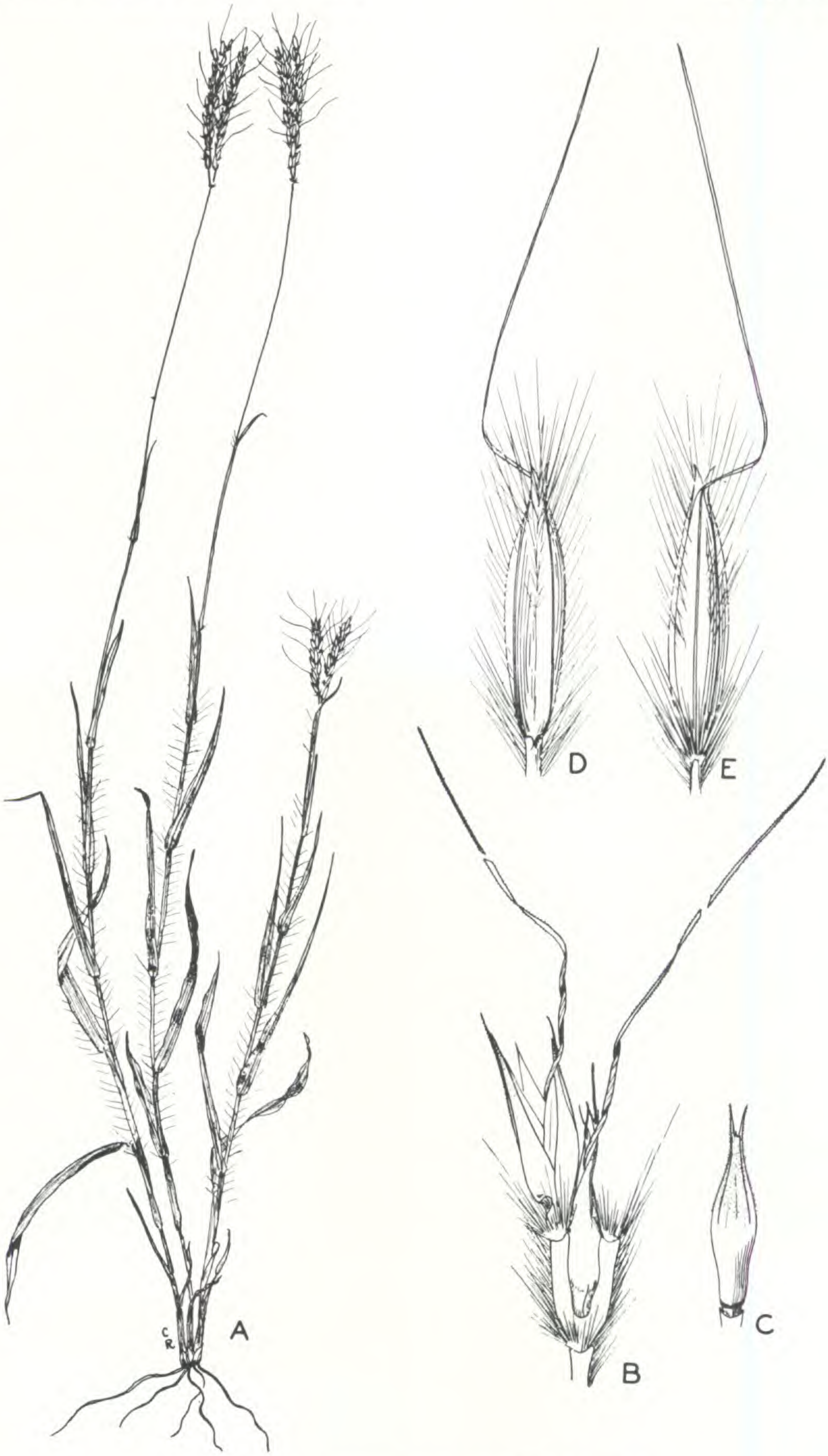

GRAMINEAE-PANICOIDEAE OF NEW GUINEA

STUDIES IN THE THEACEAE, XVII[1]
A REVIEW OF THE GENUS BONNETIA

CLARENCE E. KOBUSKI

THE GENUS *Bonnetia* Martius & Zuccarini ex Nees & Martius (1821) of the Theaceae was named for the Swiss naturalist, Charles Bonnet (1720–1793). G. Don (1831) refers to him as a French naturalist who "wrote some botanical papers in 1754." The Encyclopedia Britannica, however, refers to Bonnet as Swiss, stating that he was born at Geneva of a French family and that he never left Switzerland.

The name *Bonnetia,* as interpreted in this study, was suggested by Rehder as a *nomen conservandum* in the Kew Bull. 1935: 382. 1935, and was adopted as such in 1940 (Kew Bull. 112). In commenting upon the names to be rejected, Rehder pointed out that *Bonnetia* Schreber (1789) belonged to *Mahurea* of the Theaceae and that *Bonnetia* Necker (1790) was a synonym of the scrophulariaceous genus *Buchnera* L. The third synonym, *Kieseria* Nees (1821), although published earlier, was referred to *Bonnetia* in 1824 by Nees and Martius and was not used again by subsequent workers until 1891, when it was revived by O. Kuntze. Since the name *Bonnetia* had been more generally used by most workers than *Kieseria,* Rehder suggested its adoption.

The original publication of *Bonnetia* Martius & Zuccarini ex Nees & Martius is generally thought to have appeared in volume one, fascicle four of Martius & Zuccarini, Nov. Gen. Spec. in 1824. On the title page of this work the date 1824 is recorded. However, B. B. Woodward, in Jour. Bot. 46: 198. 1908, proved conclusively that fascicle four of Martius and Zuccarini's volume wherein *Bonnetia* appeared was not published until 1826.

Nees & Martius [Nov. Acta Phys.-Med. Acad. Leop.-Carol. **12**(1): 36. 1824] credited the name *Bonnetia* to Martius and Zuccarini but showed at the same time that the name had not been published. They stated in reference to *Bonnetia* ". . . in Martii Nov. Gen. fasc. 4., mox edendo, probabit D. Zuccarini" which can only be interpreted as of the future, "D. Zuccarini will recommend, soon to be published." Hence, instead of *Bonnetia* Martius & Zuccarini, the rather cumbersome citation *Bonnetia* Martius & Zuccarini ex Nees & Martius in Nov. Acta Phys.-Med. Acad. Leop.-Carol. **12**(1): 36. 1824 must be used.

Up to the present, *Bonnetia anceps* Martius & Zuccarini (1826) has been generally considered the standard species of the genus. However, the

[1] The abbreviations of the herbaria cited in this paper are as follows: AA = Arnold Arboretum of Harvard University; Ch = Chicago Natural History Museum; G = Gray Herbarium of Harvard University; Mo = Missouri Botanical Garden; NY = New York Botanical Garden; US = United States National Museum.

actual type is *Bonnetia stricta* (Nees) Nees & Martius (1824) (*Kieseria stricta* Nees), having received publication two years earlier. As it happens, these two species are considered conspecific in this study. It is with regret that the better known and more descriptive name *B. anceps* is relegated to synonymy under *B. stricta*.

Bonnetia Martius & Zuccarini ex Nees & Martius in Nov. Acta Phys.-Med. Acad. Leop.-Carol 12(1): 36, t. 6. 1824.— Martius & Zuccarini, Nov. Gen. Spec. 1: 114. 1826.— Cambessedes in St. Hilaire, Fl. Bras. Merid. 1: 301. 1827.— Sprengel, Syst. Veg. Cur. Post. 4(2): 206. 1827.— Cambessedes in Mém. Mus. Hist. Nat. Paris 16: 409. 1828.— G. Don, Gen. Syst. 1: 570. 1831.— Meisner, Pl. Vasc. Gen. 1: 40, 2: 30. 1836.— Endlicher, Gen. Pl. 1020. 1840.— Walpers, Repert. 1: 373. 1842.— Choisy in Mém. Soc. Phys. Hist. Nat. Genève 14: 159 (Mém. Ternstr. 71). 1855.— Turczaninow in Bull. Soc. Nat. Moscou 31(1): 246. 1858.— Bentham & Hooker f., Gen. Pl. 1: 187. 1862.— Baillon, Hist. Pl. 4: 259. 1873.— Wawra in Martius, Fl. Bras. 12(1): 323. 1886.— Oliver in Trans. Linn. Soc. Lond. ser. 2, 2: 272, pl. 37B, figs. 9–17. 1887 (ex imThurn in Timehri 5: 190. 1886).— Szyszylowicz in Nat. Pflanzenfam. III. 6: 180. 1893.— Dalla Torre & Harms, Gen. Siphon. 317. 1901.— Huber in Bol. Mus. Goeldi 7: 301. 1913.— Melchior in Nat. Pflanzenfam. ed. 2, 21: 149. 1925.— Lemée, Dict. Pl. Phan. 1: 619. 1929.— Gleason in Bull. Torrey Bot. Club 58: 395. 1931.— Rehder in Kew Bull. 1935: 382. 1935.— Gleason in Brittonia 3: 170. 1939.— Howard in Jour. Arnold Arb. 28: 125. 1947.

Kieseria Nees in Flora 4: 298. [May 21] 1821; in [Maximilian] Wied-Neuwied, Reise Brasil. 2: 338. 1821.— Kuntze, Rev. Gen. 1: 62. 1891, "*Kiesera*."— Britton in Bull. Torrey Bot. Club 41: 19. 1914.

Trees or shrubs. Leaves thick-coriaceous, alternate, congested at the apex of the branchlets in dense or loose spirals, usually obovate, rarely lanceolate, sessile or short-petiolate, the margins entire or lightly denticulate near the apex, usually pinninerved. Flowers hermaphroditic, rose, rose and white, or rich yellow, solitary or up to three on axillary peduncles, occasionally arranged in loose panicles; bracteoles when present three to a flower, quickly caducous; sepals 5, rarely more, imbricate, persistent, unequal; petals 5, convolute in the bud, flabelliform, deciduous; stamens very numerous, persistent, the filaments joined at the base, otherwise quite free, the anthers versatile, opening longitudinally or by two pores at the base, often with a rather wide connective; ovary glabrous, usually 3-celled, rarely 4-celled, the ovules very numerous, orderly arranged on thickened placentae, the styles persistent, one or three, when solitary entire or parted at the apex; stigmas one or three depending on the formation of the style, three-lobed when the style is solitary and entire. Fruit capsular, dehiscing septicidally at the apex, the margins turned inward appearing as dissepiments, the columella apparently persistent; seeds (not seen) linear, elongated above and below into a small membranous wing.

TYPE SPECIES: *Bonnetia stricta* (Nees) Nees & Martius.

KEY TO THE SPECIES

A. Styles three, free to the base.
  B. Leaves 7–12 cm. long, 2.5–5 cm. wide; anthers oblong, 1.5 mm. long; flowers yellow. ..... 1. *B. tristyla*.
  BB. Leaves minute, 0.8–1.3 cm. long, 0.5–0.6 cm. wide; anthers obcordate, 0.5 mm. long; flowers rose-colored..... 2. *B. roraimae*.

AA. Styles solitary, entire or 3-parted at apex (4-parted in *B. Steyermarkii*).
B. Style entire.
C. Flowers solitary; leaves sessile.
D. Leaves oblanceolate, 10–14 cm. long, 3–4 cm. wide with 100 or more pairs of veins; peduncle and sepals lightly puberulent...3. *B. longifolia.*
DD. Leaves rounded or broadly ovate, 2–5 cm. long, 1.5–3 cm. wide with not more than approximately 10 pairs of veins; peduncle and sepals glabrous.
E. Peduncles minute, ca. 2 mm. long; sepals 8–9 mm. long, 3–4 mm. wide; petals 6.5–8 mm. long, 5–7 mm. wide.....4. *B. tepuiensis.*
EE. Peduncles ca. 15 mm. long; sepals ca. 25 mm. long, 10 mm. wide; petals 45 mm. long, 30–40 mm. wide.....5. *B. crassa.*
CC. Flowers in racemes or subracemes; leaves petiolate.
D. Leaves somewhat oblique, oblong-subelliptic, acute at the apex.....6. *B. holostyla.*
DD. Leaves symmetrical, oblong-lanceolate, obtuse at the apex.....7. *B. venulosa.*
BB. Style 3- or 4-parted at the apex.
C. Style usually 4-parted, occasionally 3-parted, the cells of the ovary varying correspondingly; sepals 10 or 11; corolla a striking yellow.....8. *B. Steyermarkii.*
CC. Style 3-parted, ovary 3-celled; sepals 5; corolla rose-colored or white tinged with rose.
D. Peduncles strongly ancipitous.
E. Pedicel 1–2.5 cm. long; petals 3–3.5 cm. long, 2.5 cm. wide; margin of the leaf lightly denticulate toward the apex. Cuban species.....9. *B. cubensis.*
EE. Pedicel 0.5 cm. long; petals ca. 2.5 cm. long, 2 cm. wide; the margin of the leaf entire. South American species.....10. *B. stricta.*
DD. Peduncles terete.
E. Inflorescence in large, many-flowered open panicles; leaves oblique.....11. *B. paniculata.*
EE. Inflorescence of solitary flowers or in threes, not paniculate; leaves symmetrical.
F. Leaves rounded or obtuse at apex, retuse; bracteoles 3 per flower.
G. Leaves oblong-spathulate, the veins many but forming no conspicuous submarginal veins; petals 2 cm. long, 2 cm. wide at apex.....12. *B. Dinizii.*
GG. Leaves oblong-oblanceolate with conspicuous submarginal veins; petals large, 3–3.5 cm. long, 3 cm. wide at apex.....13. *B. sessilis.*
FF. Leaves linear-lanceolate, very acute at the apex; bracteoles absent.
G. Pedicel, calyx-lobes and parts of the leaves hirsute; veins of the leaves conspicuous, numerous, ca. 20 per cm.....14. *B. duidae.*
GG. Pedicel, calyx-lobes and the leaves glabrous; veins of the leaves inconspicuous, 5–7 pairs.....15. *B. lanceifolia.*

1. **Bonnetia tristyla** Gleason in Bull. Torrey Bot. Club 58: 396. 1931.

Tree 8–10 m. high. Branchlets glabrous, angled in dried state, marked with nearly circular leaf-scars, the internodes longer than in most species. Leaves not as crowded at the apex as in most species, coriaceous, glabrous, slightly oblique, oblong-obovate, 7–12 cm. long, 2.5–5 cm. wide, obtuse at the apex, tapering abruptly at the base into a stout, very short petiole ca. 2 mm. long and wide, deep green above, paler green beneath, the margin crenulate with small, spinulose teeth particularly in the upper indentations, the lateral veins elevated on both surfaces, ca. 12 pairs, arcuately

ascending, anastomosing near the margin. Flowers solitary in the upper axils; peduncles glabrous, 6–8 cm. long, exceeding the smaller upper leaves in length, swelling toward the apex; sepals 5, imbricate, glabrous, unequal, the outer two smaller, broadly elliptic, ca. 1 cm. long, obtuse at the apex, the inner three considerably larger, broadly obovate, ca. 2 cm. long, rounded at the apex; petals 5, yellow, flabelliform, 3 cm. long and ca. 3.5 cm. wide at the apex, tapering gradually from the apex to the base; stamens very numerous, the filaments thread-like, ca. 10 mm. long, joined at the base, otherwise free, the anthers oblong, ca. 1.5 mm. long, deeply lobed at the apex; ovary ovoid, 3-celled, glabrous, the styles 3, 9–10 mm. long, swelling considerably and incurved toward the apex. Fruit not seen.

VENEZUELA: Territorio Federal Amazonas: Summit of Cerro Duida, along valley forest between Central Camp and Brocchinia Hills, alt. 1675 m., *J. A. Steyermark 58108* (Ch), Aug. 31, 1944 (tree 25–30 ft. tall; flowers large, 3–4 inches in diameter, opening in late morning, the petals yellow; leaves deep green above, paler beneath).—Summit of Mt. Duida, hillsides and flat ground at Central Camp, alt. 1600 m., *G. H. H. Tate 536* (TYPE, NY; US), Dec. 20–28, 1928 (large tree).

When this species was first described it was thought to be the first instance of "free styles" in the genus. *Bonnetia roraimae* Benth. is another example of the same style-formation. However, these two species are so far removed from each other that a comparison is unnecessary.

Steyermark 58108 is a very valuable second collection of this species. This number was collected very close to the type locality and affords added information. The color of the corolla, yellow, is very unusual. This is the first instance of any color other than rose or white appearing in the genus. However, the newly described *B. Steyermarkii* also has yellow petals. Steyermark collected his specimen from a "tree 25–30 feet tall." Tate refers to his specimen as a large tree, just how large is a matter of conjecture. However, presumably it is considerably larger than 25–30 feet.

Just how strong a character the angled stem may prove to be is hard to decide with only the two specimens for comparison. In the dried state, the stem appears definitely angled. The angled condition is not continuous along the stem but appears to extend from internode to internode. In this it resembles some of the Chinese species of *Eurya*.

The very unequal calyx-lobes furnish another interesting character. The three inner lobes (20 mm.) measure nearly twice as long as the two outer lobes.

2. **Bonnetia roraimae** Oliver in Trans. Linn. Soc. ser. 2, 2: 272, pl. 37B, figs. 9–17. 1887 (ex imThurn in Timehri 5: 190. 1886).—Melchior in Nat. Pflanzenfam. ed. 2, 21: 150. 1925.—Gleason in Bull. Torrey Bot. Club 58: 397. 1931; in Brittonia 3: 171. 1939.

Shrub or small tree up to 8 m. high, the trunk as much as 30 cm. diameter. Branches glabrous, verticillate, terete, gray-brown, the branchlets purple-red, the surface often very rough because of the very close succession of leaf-scars. Leaves coriaceous, small, glabrous, congested near the ends of the branchlets in a very close spiral arrangement, oblong-obovate to oblanceolate, 8–13 mm. long, 5–6 mm. wide, broadly acute to obtuse at the apex, tapering at the base into a short petiole less than 1 mm.

long, dark green above, pale yellow- to brown-green beneath, the uppermost leaves tinged with brick or rose, the margin finely denticulate, revolute near the base, the veins obscure on both surfaces. Inflorescence usually a single flower at the apex of the branchlets, rarely two; sepals 5, imbricate, glabrous, subequal, 5–5.5 mm. long, ca. 4 mm. wide, the two outer obtuse at the apex, less rounded than the three inner ones, the margin glandular-denticulate, especially along the edge exposed in the imbricate arrangement; petals 5, pinkish white within, deep rose without, obovate, 6–8 mm. long, 4–5 mm. wide, retuse at the apex, tapering toward the base; stamens very numerous, in series, the filaments glabrous, thread-like, varying in length, the longest 3 mm. long, the shortest filaments on the exterior row, joined only at the extreme base, otherwise free, the anthers obcordate, ca. 0.5 mm. long, 0.5 mm. wide at the apex; ovary ovoid, glabrous, 3-celled, 3 mm. long, 2 mm. diameter, multi-ovulate; styles 3 or 3-parted to the base, glabrous, the stigmas three. Fruit unknown.

BRITISH GUIANA: Mt. Roraima, summit, *G. H. H. Tate 369* (NY), Nov. 24, 1927.— Roraima, *E. Ule 8708* (fragment, Ch).

VENEZUELA: State of Bolivar: Summit of Mt. Roraima, 'on northwest portion north and northwest of Summit Camp, in depressions of morros, alt. 2620–2740 m., *J. A. Steyermark 58828* (Ch), Sept. 27, 1944 (common shrub 4–8 ft. tall, the stem purple-red; leaves coriaceous, deep green above, brownish green beneath, the uppermost tinged beneath with rose or lavender; petals pinkish white within, deep rose without).— Ptari-tepuí, *Bonnetia roraimae* forest on southwest-facing shoulder, alt. 2000–2200 m., *J. A. Steyermark 59728* (Ch), Nov. 2, 1944 (shrub to small tree, 4–25 ft. tall, the trunks up to 1 ft. diameter; leaves coriaceous, dark green above, pale green beneath, the uppermost leaves tinged with brick or rose; petals rose-pink with white).— Ptari-tepuí, *Brocchinia-Stegolepis-Heliamphora* swamp on southwest-facing shoulder, alt. 2300 m., *J. A. Steyermark 59791* (Ch), Nov. 2, 1944 (depressed shrub 3 ft. tall).— Summit of Carrao-tepuí, alt. 2470–2500 m., *J. A. Steyermark 60886,* Dec. 7, 1944 (shrub or tree 3–25 ft. tall; leaves dark green above, pale green beneath; petals pink to rose).— Sororopan-tepuí, crest of cerro between east and west end, along streamlet, alt. 2256 m., *J. A. Steyermark 60144* (Ch), Nov. 14, 1944 (shrub 15–20 ft. tall).— Mt. Auyan-tepui, alt. 2200 m., *G. H. H. Tate 1153* (NY, US), Dec. 1937-Jan. 1938.— Mt. Roraima summit, alt. 8700 ft., *A. S. Pinkus 111* (Ch, G, NY, US), Jan. 9, 1939 (shrub 5 ft. high; corolla red; anthers yellow).

Bonnetia roraimae is probably the most distinctive species of the genus and most easily identified. Like so many species confined to Mt. Roraima and the adjacent similarly isolated regions, it presents characteristics very different from other members of the genus. Most noticeable is the comparative smallness of all parts of the plant. The leaves are the smallest found in the genus, measuring up to only 13 mm. long and 6 mm. wide. One specimen, *Steyermark 60144,* has leaves which exceed these measurements (2 cm. × 0.9 cm.), but these are still very small for the genus. The close spiral arrangement of the leaves, the minute denticulations along the margin, and the absence of visible veins are also excellent characters of distinction. The anthers are distinctly obcordate, a feature which differs from all other previously described anthers.

When Oliver first described the species he referred to the many stamens as being arranged in five "phalanges." The stamens were illustrated just so, with the filaments joined at the base for one-half the distance of the shortest stamens. This same character has been used in various keys by

later botanists to distinguish the species. The stamens, when first observed in a dissection of a bud, appear to occur in clumps or groups. However, close examination fails to show this arrangement. They appear more likely to be arranged in series, the shortest stamens comprising the outer series. The filaments are free to the base. Two open flowers and one bud were examined.

The corolla and calyx are correspondingly small. The margins of the calyx-lobes are glandular-denticulate, especially along the edge exposed in the imbricate arrangement. This character, very common in other genera of this family, is quite rare in *Bonnetia*.

The styles may be classified as 3-parted to the base or as 3 distinct styles. This character is found also in Gleason's species, *B. tristyla*.

3. **Bonnetia longifolia** Gleason in Bull. Torrey Bot. Club 58: 396, 397. 1931.

Large tree. Branchlets leafless except at the apex, terete, glabrous, reddish brown, the cortex smooth, birch-like, sparsely marked with very wide but short leaf-scars. Leaves crowded at the end of the branchlets, coriaceous, glabrous, oblanceolate, somewhat oblique, 10–14 cm. long, 3–4 cm. wide, broadly acute to obtuse at the apex, retuse, tapering from the middle to the base, sessile, the margin entire, many pairs of veins (over 100) elevated on both surfaces, ascending at an angle of 60°, running parallel and straight to the margin without anastomosing until they join in a single close rather inconspicuous submarginal vein. Flowers terminal or axillary ?, at or near the ends of the branchlets; peduncle stout, 2 cm. long, finely puberulent; sepals 5, coriaceous, lightly puberulent on the exterior surface, broadly elliptical, ca. 2 cm. long and 1 cm. wide, rounded at the apex, the margin membranaceous; petals 5, flabelliform, pink, ca. 4 cm. long, about as wide near the apex, tapering to the base; stamens very numerous, the filments filiform, ca. 10 mm. long, joined at the base, otherwise free, the anthers linear, 5–6 mm. long, ca. 0.5 mm. wide; ovary ovoid, 8 mm. long, 3-celled; style straight and slender, 10 mm. long, entire, the stigma obscurely 3-lobed. Fruit not seen.

VENEZUELA: Summit of Mt. Duida, hillsides and flat ground at Central Camp, alt. 1600 m., *G. H. H. Tate 537* (TYPE, NY; US), Dec. 20–26, 1928 (large trees; flowers large, pink, the anthers waxy-yellow).

Only a single collection of this species, the type, has been available for this study. Because the flowers are both very few and large, I have made no dissections, but have depended upon the description of Gleason for the parts not easily discernible.

The branchlets are very distinctive, appearing as though they might have been succulent in the fresh state. On the specimen the cortex, which is very smooth and birch-like, seems to have been separated from the inner layers of the stem in drying.

The long leaves are marked by straight parallel veins, more numerous than in most species. These veins rise from the midrib at an angle of 60° and run parallel almost to the very margin without joining in any manner. At the margin they form a single submarginal vein running the length of the leaf very close to the margin itself.

Gleason described the flowers as "3 or 4, terminal." None of the flowers

are attached at present to the stem. Since there is no evidence of any type of inflorescence, it may be possible that the flowers are axillary near the apex. The fine puberulence of the peduncle and sepals is a most unusual character for the genus, appearing also only in *B. duidae* Kobuski & Steyermark.

4. **Bonnetia tepuiensis** Kobuski & Steyermark, sp. nov.

Arbor parva 8–12 m. alta (vel frutex ca. 1 m. altus); trunco 20 cm. diam., cortice griseo-brunneo, sulcato, ramulis verticillatis vel affinibus, teretibus, glabris, griseis. Folia coriacea, ad apicem ramulorum conferta, patenti-adscendentia, sessilia, glabra, late ovata, 2–2.8 cm. longa, 1.5–1.8 cm. lata, apice obtusa, retusa, basi rotundata, margine minute denticulata, revoluta, costa supra plana subtus elevata, venis ca. 5–6 paribus, undique inconspicuis. Flores axillares solitarii; pedunculis teretibus, glabris, minutis, ca. 2 mm. longis et in diam.; sepalis 5, imbricatis, glabris, lanceolatis, 8–9 mm. longis, 3–4 mm. latis, apice acuminatis ad basim latissimis, margine scariosis; petalis (immaturis) 5, late obovatis, roseo-albis, 6.5–8 mm. longis, apice 5–7 mm. latis, ad basim attenuatis; staminibus numerosis; filamentis filiformibus, liberis basi exceptis, ca. 3 mm. longis; antheris oblongis, ca. 1 mm. longis; ovario ovoideo, glabro, 4 mm. longo, 2.5 mm. diam., 3-loculari, multi-ovulato; stylo integro, glabro, 3-sulcato, 1.5 mm. longo. Fructus non visus.

VENEZUELA: Bolivar: Lower southeastern slope of Carrao-tepuí, in woods, alt. 1675–1980 m., *J. A. Steyermark 60871* (TYPE, Ch), Dec. 5–6, 1944 (tree 20–35 ft., the trunk branched, up to 8 inches diameter, the bark dark gray-brown, furrowed; leaves coriaceous, spreading-ascending, deep green above, dull green beneath, with purple-red or wine-red margin; petals white, tinged with pink at the tips or along the margins).— Summit of Carrao-tepuí, in open places or surrounding open places with *B. roraimae,* alt. 2500 m., *J. A. Steyermark 60902* (Ch), Dec. 7, 1944 (shrub or bush, 3–4 ft.).

This species is most closely related to *B. roraimae* Oliver. Both species have universally small leaves and flowers. In both species the leaves have a tendency, although concentrated at the apices of the branchlets, to terminate the branchlet in a dense rosette. The flowers are nestled, solitary, in this rosette of leaves. The general arrangment of leaves does, however, in both species extend farther down the branchlets than in most other species of the genus.

There are notable differences between the two species. In *B. roraimae* the leaves are the smallest to be found in the genus, measuring only ca. 1 cm. long and about half as wide. The sepals are smaller and more or less rounded with glandular-denticulate margins. The stamens are of varying length with obcordate anthers. The style is 3-parted to the base. In *B. tepuiensis* the leaves are nearly three times as long and rounded at their apices. The sepals are lanceolate rather than rounded and the margins are entire; the anthers are oblong and the style is entire.

According to Steyermark, these two species grow in the same locality on Carrao-tepuí.

5. **Bonnetia crassa** Gleason in Bull. Torrey Bot. Club 58: 395, 397. 1931; in Brittonia 3: 170. 1939.

Shrub or tree. Branchlets glabrous, naked except for a few leaves at

the summit, stout, densely marked by leaf-scars, the internodes very short. Leaves coriaceous, sessile, in spirals at the apex of the branchlets, glabrous, obovate, 4–5 cm. long, 2–3 cm. wide, rounded at both apex and base, shining deep rich green above, dull green beneath, the margin entire, ciliate when very young, the veins conspicuous on the upper surface, ca. 10–12 pairs, rising from the midrib at a 45° angle and arching gracefully upward toward the margin joining only near the apex. Flowers solitary; peduncle stout, ca. 1.5 cm. long, glabrous; sepals 5, imbricate, glabrous, oblong, ca. 2.5 cm. long, 1 cm. wide, acute and cuspidate at the apex, the margin entire, scabrous; petals 5, broadly flabelliform, rose to white tinged with pink, 4.5 cm. long, 3–4 cm. wide at the apex, lightly retuse; stamens very numerous, the filaments filiform, joined at the base, otherwise free, ca. 1.5 cm. long, the anthers minute 0.1 cm. long; ovary narrowly ovoid, ca. 7 mm. long, ridged, 3-celled, gradually tapering into a stout, erect, entire style, the stigma 3-lobed. Fruit not seen.

VENEZUELA: Territorio Federal Amazonas: Summit of Mt. Duida, hillsides and flat ground at Central Camp, alt. 1600 m., *G. H. H. Tate 539* (TYPE, NY; US), Dec. 20–28, 1928 (large tree with pinkish white flowers).—Same locality, slope of Ridge 25, alt. 1800–2000 m., *G. H. H. Tate 413* (NY), Nov. 26-Dec. 16, 1928 (leaves in whorls of 3; flowers pink with curled petals).—Same locality, Brocchinia Hills, alt. 1700–1800 m., *J. A. Steyermark 58182* (Ch), Sept. 1, 1944 (shrub 15–25 ft. tall; leaves coriaceous, at tips of branches, deep rich green above, dull green beneath; petals deep rose to white tinged with pink).

This species is most closely related to *B. sessilis* Benth. However, it can be separated from *B. sessilis* by the entire style, the longer, acuminate sepals and larger petals.

Besides the two original specimens studied by Gleason, I had at my disposal an excellently preserved specimen from the type-locality collected by Steyermark. This added material, in beautiful condition, agreed in all respects with Gleason's original well-composed description.

There is considerable variation in the stature of this species. Tate records it as a large tree while Steyermark lists it as a shrub "15–25 ft. tall."

6. **Bonnetia holostyla** Huber in Bot. Mus. Goeldi 7: 301. 1913.—Melchior in Nat. Pflanzenfam. ed. 2, 21: 150. 1925.—Gleason in Bull. Torrey Bot. Club 58: 397. 1931.

Small tree. Branchlets glabrous, terete, reddish purple. Leaves somewhat oblique, oblong-subelliptic, glabrous, 6–12 cm. long, 3–4 cm. wide, broadly acute and emarginate at the apex, cuneate at the base, the margin entire, the veins lightly raised on both surfaces, many pairs, rising at an acute angle from the midrib running parallel nearly to the margin then ascending, the petiole ca. 3 mm. long. Inflorescence subracemose, the lower peduncles glabrous, 1–1.5 cm. long, usually 2- or 3-flowered, the upper peduncles usually single-flowered, the pedicels short, ca. 4 mm. long; sepals 5, imbricate, glabrous, ca. 1 cm. long, subrotund at the apex, scarious at the margin; petals 5, flabelliform, emarginate, rose-colored, 15–17 mm. long, ca. 10 mm. wide, widest at the apex, tapering toward the base; stamens very numerous, the filaments thread-like, free, ca. 10 mm. long; ovary conical, tapering in a long style, 14 mm. long, entire its whole length, the stigma broadly 3-lobed.

COLOMBIA: "Hab. in cacumine montis Cupaty ad fl. Yapurá-Caquetá," *A. Ducke 12315* (ISOTYPE US; photo Ch, G), Nov. 27, 1912.

This rare species appears to have been collected only once. Fortunately, we were able to examine an isotype deposited in the U. S. National Herbarium. The specimen is rather poor, having been collected with immature fruit. However, the style is clearly entire with a 3-lobed stigma showing no tendency to split.

Another interesting character, not mentioned by the author, is the oblique leaf. This characteristic is not as pronounced as in *B. paniculata* Spruce but is quite obvious, and I am of the opinion that it is with this species that its closest affiliation lies, rather than with *B. sessilis* Bentham as suggested by the author.

7. **Bonnetia venulosa** Martius & Zuccarini, Nov. Gen. Sp. 1: 115. 1826.—Sprengel, Syst. Veg. Cur. Post 4(2): 207. 1827.—G. Don, Gen. Syst. 1: 570. 1831.—Walpers, Repert. Bot. Syst. 1: 373. 1842.—Choisy in Mém. Soc. Phys. Hist. Nat. Genève 14: 159 (Mém. Ternstr. 71). 1855.—Wawra in Martius, Fl. Bras. 12(1): 325. 1886.—Melchior in Nat. Pflanzenfam. ed. 2, 21: 150. 1925.—Gleason in Bull. Torrey Bot. Club 58: 397. 1931.

Kiesera venulosa (Mart. & Zucc.) O. Kuntze, Rev. Gen. Pl. 1: 62. 1891.

Haemocharis venulosa (Mart. & Zucc.) O. Kuntze, Rev. Gen. Pl. 1: 62. 1891.

Small tree. Leaves oblong-lanceolate, 7–8 cm. long, ca. 5 cm. wide, obtuse, attenuate at the base into a petiole 6 mm. long, entire, glabrous, the midrib prominent beneath, the veins close, parallel. Flowers terminal, disposed in a composite raceme; calyx-lobes subequal, glabrous, ovate to suborbicular, obtuse at the apex; corolla unknown; stamens very numerous, the filaments irregularly connate at the base, free above, filiform, glabrous, persistent. Capsule conical, the calyx and filaments persistent, attenuated into the style, 3-celled, 3-valved, the valves ovoid, acute, subwoody on the external surface, glabrous, showing dissepiments with thin inturned margins, dehiscing introrsely from the apex, nevertheless joined inter se with the persistent style; the central receptaculum 3-angled, pushing into the locules and placentae with prominent thick angles, connate with the margins of the valves; seeds linear, minute, with crisp membranous brown wings at both the apex and the base.

NO SPECIMENS EXAMINED.

Since no specimens of this species have been available for this study it has been necessary to rely upon the original description of Martius & Zuccarini, a translation of which is given above. Wawra in his work for Martius' Flora Brasiliensis did not see the type-specimen, or any specimen for that matter. This seems puzzling considering the fact that the species was described by Martius and Zuccarini.

It may be that the specimen had been placed in another genus before Wawra worked on the family. The description seems to apply well to *Bonnetia*. However, no description of the corolla was made by Martius and Zuccarini. It is possible that it may belong to *Mahurea* of the Guttiferae, but this is merely an assumption on my part. Until it can be shown with certainty that it belongs elsewhere, I feel that I should accept it, as have other workers before me.

8. **Bonnetia Steyermarkii** Kobuski, sp. nov.

Frutex 5–8 m. altus; ramulis glabris, griseo-brunneis. Folia coriacea, glabra, elliptica vel elliptico-ovata, sessilia vel subsessilia, 7–9 cm. longa, 3–4 cm. lata, supra atro-viridia, subtus luteo-viridia vel rosea, apice obtusa vel subrotundata, basi rotundata, margine minute denticulata juventute ciliata, costa glabra basi expansa, supra plana, subtus elevata, nervis ca. 12 paribus, undique elevatis, arcuato-adscendentibus margine anastomosantibus. Flores apice ramulorum, axillares, solitarii; pedunculis crassis, ancipitibus, glabris, 3–5 cm. longis, ad 5 mm. latis, apice accrescentibus, alatis, alis 1 mm. latis; sepalis imbricatis, ca. 11, subaequalibus, glabris, ovato-lanceolatis, apice apiculatis, ca. 1.7 cm. longis, 0.6–0.7 cm. latis, sepalis interioribus latioribus; petalis 5, luteis, flabelliformibus, 3.5 cm. longis, 2.7 cm. latis; staminibus plurimis; filamentis filiformibus, glabris, 7 mm. longis, liberis basi exceptis; antheris suborbicularibus, ca. 1 mm. longis; ovario ovoideo 3- vel 4-loculari, glabro, multi-ovulato, stylo glabro, 7–8 mm. longo, 3- vel 4-partito, apice ca. 3 mm. diviso, stigmatibus 3 vel 4. Fructus non visus.

VENEZUELA: State of Bolivar: Ptari-tepuí, on densely forested steep south-facing slopes overlying sandstone, between "Cave Rock" and base of high sandstone bluffs, alt. 2285–2400 m., *J. A. Steyermark 59570* (TYPE, Ch), Oct. 30, 1944 (common shrub 15–25 ft. tall, forming impenetrable thickets with curving matted intertwining stems; leaves deep green or bronze above, dull paler green beneath or suffused with rose or lavender especially on the youngest leaves, the margins purplish red; sepals pale green with rose-red margins or suffused with rose-red; petals rich yellow).— Ptari-tepuí, *Bonnetia roraimae* forest on southwest-facing shoulder, alt. 2000–2200 m., *J. A. Steyermark 59794* (Ch), Nov. 2, 1944 (common; leaves deep green above, dull green beneath; petals rich yellow).— Auyan-tepuí, alt. 2200 m., *G. H. H. Tate 1165* (NY), Dec. 1937.

This remarkable species has been recorded from both Ptari-tepuí and Auyan-tepuí, and the field notes of *Tate 1165* state that it also grows on Mt. Duida.

In the broad thick leaves, stems, and large flowers it resembles *B. crassa* Gleason. However, in *B. crassa* the ovary is always 3-celled, the style entire, the sepals 5 in number, the stigma 3-lobed, and the corolla larger and red or rose in color.

Bonnetia Steyermarkii is different from all other species in the increased number of sepals, the 4-celled ovary, and the 4-parted style. The sepals are double the number usually found in the rest of the genus. Careful dissection shows at least two rows of sepals with little variation, the outer sepals, perhaps, somewhat more narrow than the inner sepals. In all dissections the ovary proved to be 4-celled and the style 4-parted. The division of the style, in future collections, may prove to be even greater. If the flowers are softened by boiling, one can easily separate the styles to the base. This is not the case in other species. One style, in the specimen of *B. Steyermarkii* examined, appeared to be 3-parted. No dissection of this style (and ovary) was made because of the paucity of material. However, in his notes Steyermark refers to "3–4 styles free for 2.5 mm. above."

This is the second species with yellow petals, the other species being

B. tristyla Gleason. The collector refers to this color as rich yellow, so one cannot confuse it with white. In most other species rose or pink appear dominant with white and rose also recorded.

It is with pleasure that I name this distinctive species in honor of Dr. Julian A. Steyermark, who collected three of the new species described in this paper. His excellent material of other species in the genus has aided considerably in this study.

9. **Bonnetia cubensis** (Britton) Howard in Jour. Arnold Arb. 28: 125. 1947.
Kieseria cubensis Britton in Bull. Torrey Bot. Club 41: 19. 1914.

Large tree; branchlets stout, reddish brown, glabrous, terete, often very wrinkled when dry. Leaves coriaceous, glabrous, oblong-obovate, 6–11 cm. long, 2.5–3 cm. wide, obtuse or rounded at the apex, long-tapering at the base, sessile or subsessile, the upper surface of the young leaves covered with a grayish bloom, the margin lightly denticulate toward the apex, the midrib plane above, elevated beneath, the veins conspicuous above, ca. 20 pairs, rising from the midrib at an acute angle, extending parallel toward the margin, presently arcuate-ascending. Flowers solitary, in the axils of the uppermost leaves; peduncles glabrous, stout, ancipital, 3–5 cm. long, with as many as 4 bracts at the apex, the bracts obovate, glabrous, sessile, 11–13 mm. long, 6–7 mm. wide, obtuse or rounded at the apex, sessile, lightly denticulate at the apex, the pedicel stout, subterete, 1–2.5 cm. long; sepals 5, imbricate, persistent, glabrous, unequal, the outer sepals broadly ovate, ca. 1.5 cm. long and 1 cm. wide, the inner sepals subrotund, ca. 2 cm. long and 1.5 cm. wide, the scarious margin more extensive on the inner sepals up to 5 mm. wide, lightly denticulate toward the apex; petals 5, rose, glabrous, broadly flabelliform, 3–3.5 cm. long, ca. 2.5 cm. wide; stamens very many, the filaments glabrous, filiform, unequal, ca. 10 mm. long, joined at the base, otherwise free, the anthers globular, ca. 1.5 mm. long and 1 mm. wide; ovary subconical, glabrous, ca. 5 mm. long, 3-celled, multi-ovulate, tapering at the apex into a glabrous, 3-parted style, ca. 8 mm. long, the stigmas 3. Capsule ca. 1.5 cm. long, 3-celled.

CUBA: Oriente: Moa: Vicinity west of Camp San Benito, alt. 900 m., *J. A. Shafer 4066* (NY, US), Feb. 24, 1910 (tree 20–40 ft., the largest tree in this region).— Camp La Gloria, across Sierra Moa to Moa Bay, *J. A. Shafer 8283* (Ch, NY, US), Dec. 31, 1910–Jan. 1, 1911 (tree 20 ft., much branched).— Camp La Gloria, south of Sierra Moa, *J. A. Shafer 8121* (NY, TYPE; Mo), Dec. 24–30, 1910 (tree up to 40 ft. high; capsules dry).— Punta Gorda River, near the bridge close to the sea, *Marie Victorin, Clément, & Alain 21436* (G), Apr. 16–23, 1943 (large tree in the semi-deciduous forest).— 15 km. southwest of Companie de Moa mills, in dense woods, *R. A. Howard 5842* (G), July 26, 1941 (tree 15 ft. high; flowers pink).

The presence of this species in Cuba is baffling. It appears to be confined to the small Moa area in Oriente, Cuba, since it has not been recorded from any other area of Cuba or the West Indies. Furthermore, it is the only species of *Bonnetia* found outside of South America.

This species has not been included in any previous treatment of the genus and it was not until 1947 that Howard transferred the species from *Kieseria* to *Bonnetia*.

Up to the present treatment, the flowers of this species had not been described. Dissections made from the flowers of *Howard 5842* furnished

the data in the above description. There is a very close relationship between this species and *B. stricta* Nees & Martius from Brazil. *Bonnetia cubensis* can be separated from the latter species by the length of the pedicel (1–2.5 cm. long) and petals (3–3.5 cm. long, 2.5 cm. wide) and the lightly denticulate margin on the leaves. In *B. stricta* the pedicel measures ca. 0.5 cm. and the petals 2.5 cm. in length. The margin of the leaves is entire. The greatest difference is the area of distribution of the two species, *B. cubensis* being confined to a small area in Cuba, and *B. stricta* in Brazil.

10. **Bonnetia stricta** (Nees) Nees & Martius in Nov. Acta Phys.-Med. Acad. Leop.-Carol. 12: 37, t. 6. 1824.— G. Don, Gen. Syst. 1: 570. 1831.— Walpers, Repert. Bot. Syst. 1: 373. 1842.— Choisy in Mém. Soc. Phys. Hist. Nat. Genève 14: 159 (Mém. Ternstr. 71). 1855.— Wawra in Martius, Fl. Bras. 12(1): 324. 1886.— Melchior in Nat. Pflanzenfam. ed. 2, 21: 150. 1925.— Gleason in Bull. Torrey Bot. Club 58: 397. 1931.

Kieseria stricta Nees in Wied-Newied, Reise Bras. 2: 338. 1821.

Bonnetia anceps Martius & Zuccarini, Nov. Gen. Sp. 1: 115. 1826.— Cambessedes in St.-Hilaire, Fl. Bras. Merid. 1: 302. 1827.— Sprengel, Syst. Veg. Cur. Post 4(2): 207. 1827.— G. Don, Gen. Syst. 1: 570. 1831.— Spach, Hist. Nat. Veg. 4: 76. 1835.— Walpers, Repert. Bot. Syst. 1: 373. 1842.— Schnitzlein, Iconogr. 3: t. 215. 1852.— Choisy in Mém. Soc. Phys. Hist. Nat. Genève 14: 159 (Mém. Ternstr. 71). 1855.— Baillon, Hist. Pl. 4: 236. 1873.— Wawra in Martius, Fl. Bras. 12(1): 326, pl. 67, fig. 3. 1886.— Szyszylowicz in Nat. Pflanzenfam. III. 6: 181. 1893.— Melchior in Nat. Pflanzenfam. ed. 2, 21: 149, fig. 66A. 1925.— Gleason in Bull. Torrey Bot. Club 58: 397. 1931.

Bonnetia bahiensis Turczaninow in Bull. Soc. Nat. Moscou 31: 246. 1858.

Bonnetia anceps typica Wawra in Martius, Fl. Bras. 12(1): 326. 1886.

Kielmeyera bracteosa Martius ex Wawra in Martius, Fl. Bras. 12(1): 326. 1886, in synon.

Bonnetia anceps vars. α and β Wawra in Martius, Fl. Bras. 12(1): 326. 1886.

Kielmeyera Schottii Pohl ex Wawra in Martius, Fl. Bras. 12(1): 326. 1886, in synon.

Haemocharis stricta (Nees) O. Kuntze, Rev. Gen. Pl. 1: 62. 1891.

Kiesera anceps (Mart. & Zucc.) O. Kuntze, Rev. Gen. Pl. 1: 62. 1891.

Haemocharis anceps (Mart. & Zucc.) O. Kuntze, Rev. Gen. Pl. 1: 62. 1891.

Shrub or small tree 3–5 m. high, the branchlets thick, glabrous, terete, leafless except at or toward the apex, conspicuously dotted by the large leaf-scars, purple-brown, the cortex shriveled in the dried state, obviously succulent in fresh material, often glaucous near the apex. Leaves coriaceous (drying as though succulent in fresh state) oblong-obovate, 7–14 cm. long, 3–5 cm. wide, obtuse to rounded at the apex, long-attenuate or sessile at the base, glabrous on both surfaces, reddish purple and glaucous above, yellow-green beneath with the midrib and occasionally other portions reddish, the margin entire, subrevolute (when dried), the midrib flat or slightly canaliculate above, raised beneath, the veins up to ca. 20 pairs, closely arranged, somewhat parallel, ascending at an abrupt angle toward the margin then arching upward along the margin toward the apex. Inflorescence axillary, the peduncle ancipitous, glabrous, 2–4 cm. long (occasionally up to 6 cm. long), usually one-flowered, occasionally three-flowered, accrescent toward the apex, the pedicels (when present) short, up to 5 mm. long; bracteoles 3, subsepaloid, somewhat rounded, the middle one more elongate, ca. 6–9 mm. long; sepals 5, imbricate, coriaceous,

glabrous, persistent, unequal, the outer two thicker, more nearly rounded, ca. 12 mm. long, the inner three more elongate, thinner, the margins entire, scarious especially on the inner sepals; petals 5, glabrous on both surfaces, rose-colored or white with rose, obcordate, up to 2.5 cm. long, ca. 2 cm. wide at the apex, emarginate, tapering quite abruptly to the base (ca. 0.5 cm. wide); stamens very numerous, about one-half the length of the corolla, the filaments filiform, joined at the base, otherwise free, the anthers oblong, ca. 1 mm. long; ovary conical, ca. 4 mm. long, 2.5–3 mm. thick at base, glabrous, 3-celled, multi-ovulate, tapering into a short style approximating the ovary in length, three-parted at the apex. Fruit (according to other authors) ovoid, 1–1.5 cm. long, 3-celled, many-seeded.

BRAZIL: Rio de Janeiro: In sandy swamps near Rio de Janeiro, *H. Schott 1605* (G).- Bahia: Igreja Velha, *J. S. Blanchet 3363* (ISOTYPE of *B. bahiensis* Turcz., AA, Ch), 1841; exact locality missing *J. S. Blanchet 1416* (Ch), *1700* (Ch), 1834. Locality lacking *H. Schott ?281* (Ch).

For the past 80 years, *Bonnetia stricta* has been encountered only in keys, never in collections. The main reason is because of the misinterpretation of Wawra, in his treatment of the genus in Martius, Fl. Bras. Wawra separated this species from all others in the group by the "membranaceous" leaves. Considering the heavy texture of the leaves I have encountered in species of the genus, I doubt if any species has been found or will be found with this type of foliage.

In 1821, when the species was first mentioned under the new genus *Kieseria* by Nees, a German description signified: a shrub 8–10 ft. high, with long, cuneate, blunt entire-margined juicy-coriaceous leaves and large white flowers which appear in twos, each one provided with three bracts at the base, and stand on short peduncles in the axis of the upper leaves. Nees used the word "saftiglederartigen" to describe the leaves in his German description. The only translation that could be used is "juicy-leathery," a far cry from membranaceous.

Later, in the same year, a latin description appeared, as follows: ". . . Kieseria stricta des Herrn Prof. Nees v. Esenbeck: Classis Linneana Polyandria Polygynia; Fam. Nat. Guttiferarum. Corolla penta petala, petalis integris. Calyx quinque-partitus, bracteatus. Antherae erectae liberae. Germen triloculare, septis simplicibus, loculis monospermis." This description now applied to the species *Kieseria stricta* is the same as the original generic description except for a few transpositions of phrases. It should be noted that in this description the filaments are described as "liberis" or free.

In 1824, three years later, Nees and Martius transferred the species to the new genus *Bonnetia* and presented a much more complete Latin description. Accompanying the description is a plate. In the description the leaves are described as carnose-coriaceous, and the plate carries this out. The filaments, recorded as free in the original description, are not mentioned here. However, the plate distinctly shows them as free.

In 1827, Sprengel, recognizing the close relationship between *B. stricta* and the latter, described *B. anceps* and combined the two under the more recent name. Walpers, in 1842, again recognized both *B. stricta* and *B.*

anceps. His descriptions of the two were identical except that he mentioned the filaments of *B. anceps* as free. Since he did not mention the filaments of *B. stricta* there was no basis for comparison, and according to the illustration of *B. stricta* and a statement in the original description, the filaments are free.

Choisy, in 1855, recognized both species and noted that the peduncles of *B. stricta* were shorter and closer together than those of *B. anceps*. He mentioned that the two species could be separated only with difficulty. In closing he reminded the reader that Sprengel had united the two species and finally suggested that perhaps he (Sprengel) was right!

The first complete treatment of the genus was made by Wawra de Ternsee for Martius' Fl. Bras. in 1886. In this work, *B. stricta* was separated from all other species of the genus by a statement in the key that the leaves were membranous. In his description which followed, the earlier statement was tempered by a reference to the leaves as submembranaceous. Just what Wawra had before him or in mind is difficult to understand. Nees clearly described the leaves as "juicy-coriaceous" in his original German text, and later Nees and Martius, in transferring the species to *Bonnetia,* used the term coriaceous. Perhaps Wawra did not see a specimen of *B. stricta*. Melchior (1925), in his treatment of the Theaceae in the second edition of Nat. Pflanzenfam., followed the work of Wawra and separated *B. stricta* from the other members of the genus on the character of membranous leaves. This same character was used by Gleason (1931), who stated, however, that his key was merely an amplification of Melchior's key to show where his three new species described from Venezuela would fit in Melchior's interpretation.

Wawra, in the diagnostic portion of his description of *B. stricta,* stated clearly that the filaments were free. Later, on the same page, he again referred to the filaments, this time stating that they were joined at the base in fascicles. Both Melchior and Gleason used the latter reference to the filaments, rather than the former, in their respective keys.

Remove the differences in filaments and leaf-texture, and the only variation between the two species so far recorded in literature is the length of the peduncle as cited by Choisy. The illustration of Nees and Martius shows the peduncles to be shorter than those in mature herbarium specimens labeled *B. anceps,* true enough. But the illustration depicts, for the most part, only buds or undeveloped inflorescences. Several specimens cited above, and previously interpreted as *B. anceps* by Wawra, in bud possess short peduncles. Mature flowering specimens exhibit peduncles up to 5 cm. or more. The closeness of the type-localities of the two species along with the fact that *B. stricta* has not been collected, as such, since Martius' treatment, should arouse anyone's suspicions as to whether or not they represent separate entities.

11. **Bonnetia paniculata** Spruce ex Bentham in Jour. Linn. Soc. 5: 63. 1861.— Wawra in Martius, Fl. Bras. 12(1): 325. 1886.— Oliver in Trans. Linn. Soc. ser. 2, 2: 271. 1887.— Szyszylowicz in Nat. Pflanzenfam. III. 6: 181. 1895.— Melchior in Nat. Pflanzenfam. ed. 2, 21: 149, fig. 66 B-D. 1925.— Gleason in Bull. Torrey Bot. Club. 58: 397. 1931.

Bonnetia parviflora Spruce ex Bentham in Jour. Linn. Soc. 5: 63. 1861.
Bonnetia paniculata typica Wawra in Martius, Fl. Bras. 12(1): 325. 1886.
Bonnetia paniculata Spruce ex Benth. var. *parviflora* (Spruce ex Benth.) Wawra in Martius, Fl. Bras. 12(1): 325, pl. 67. 1866.
Kiesera paniculata (Spruce ex Benth.) O. Kuntze, Rev. Gen. Pl. 1: 62. 1891.

Small tree 5–10 m. high with rough bark. Branchlets terete (striate in the dried state), glabrous, reddish purple, the leaf-scars as much as 3 cm. apart. Leaves coriaceous, glabrous, oblique, oblong-obovate, 8–12 cm. long, (2.5–)3–5 cm. wide, usually rounded or obtuse at the apex, acute in the narrower leaves, long-attenuate at the base, deep green above, dull rich green beneath, the margin entire, the veins many, close, conspicuous on both surfaces, rising sharply from the midrib and ascending parallel to the margin, the petiole 5 mm. long. Inflorescence laxly paniculate, each penduncle in the axil of a miniature leaf which is quickly caducous giving the appearance of a leafless panicle; peduncles glabrous, brownish red, compressed, branched or unbranched, usually three-flowered, the lower peduncles longest, up to 5 cm. long, gradually decreasing in length toward the apex, appearing pyramidal; pedicels 5–10 mm. long, angled, usually in threes, the bracteoles quickly caducous, the scars or vestiges evident; sepals 5, coriaceous, dull green tinged with red, somewhat rounded-elliptic, ca. 1 cm. long, 6–7 mm. wide, the margin entire, subscarious, the inner sepals larger; petals 5, emarginate, up to 2 cm. long, ca. 1.5 cm. wide at the apex tapering abruptly to base, white or white tinged with pink or rose; stamens many, the filaments thread-like, joined at the base, otherwise free, glabrous, 8–10 mm. long, the anthers minute, ca. 1 mm. long; ovary conical, glabrous, ca. 3–4 mm. diam. tapering at the apex into a style which is 3-parted at the apex, ca. 8–9 mm. long, sometimes shorter. Capsule (including style) ca. 2 cm. long.

PERU: Dept. San Martín: Near Tarapoto, *R. Spruce 4809* (ISOTYPES Ch, G, NY), 1855–56.— Near Tarapoto, *R. Spruce 4239* (ISOTYPES of *B. parviflora,* Ch, G, NY), 1855–56.— Tarapoto, alt. 750 m., *L. Williams 5955* (Ch, US), *5974* (Ch, US), Dec. 1929.— San Roque, alt. 1350–1500 m., *L. Williams 7674* (AA, Ch, US), Feb. 4, 1930.— Zepelacio, near Moyobamba, mountain forest, alt. 1200–1600 m., *G. Klug 3450* (AA, Ch, G, Mo, NY, US), Dec. 1933 (tree 5 m. high with bright rose flowers).

VENEZUELA: Terr. Amazonas: Aguita, slopes of Mt. Duida, alt. 1300 m., *G. H. H. Tate 928* (NY), Aug. 1928–Apr. 1929 (flowers large red-pink). Bolivar: Gran Sabana, between Mission of Santa Teresita de Kavanayén northwest to Río Karuai, on border of steep woods bordering savanna, alt. 1220 m., *J. A. Steyermark 59379* (Ch), Oct. 26, 1944 (tree 10 m. tall; leaves coriaceous, deep green above, dull rich green beneath; sepals dull green tinged with brownish brick, as are the peduncles and pedicels; petals white or white tinged with pink).— Wooded slopes of Quebrada O-paru-má, between Santa Teresita de Kavanayén and Río Pacairao (tributary of Río Mouak), upper drier part of forest below mesa, alt. 1065–1220 m., *J. A. Steyermark 60356* (Ch), Nov. 20–21, 1944 (small tree 10 m. tall with coriaceous leaves deep green above, dull green beneath).

BRAZIL: Amazonas: "Rio Curicuriary (affl. Rio Negro) ad ripas cataractae Cajú, 'catinga,'" *A. Ducke 345* (AA, Ch, Mo, NY, US), Nov. 18, 1936 (small tree with white flowers).— "Rio Curicuriary affl. Rio Negro super, ad ripam saxosam cataractae Cajú," *A. Ducke 23741* (US), Oct. 20, 1932 (small tree with white flowers).

BRITISH GUIANA: Region of Mt. Roraima, "Our House," alt. 1900 m., *E. F. imThurn 135* (US), Dec. 9, 1884.

As the specific name indicates, this species is chiefly characterized by

the paniculate inflorescence. The panicles are large and spreading, pyramidal in shape with the lower peduncles longest and those above increasingly shorter. This inflorescence has often been described as a leafless panicle. Although it usually appears leafless, each peduncle arises from the axil of a leaf which is quickly caducous even in the early flowering stage. The flowering leaves, like the peduncles, decrease in size as they near the apex of the inflorescence. Occasional leaves may be seen in the inflorescence. If not present, a leaf-scar remains to show its erstwhile presence.

The oblique leaves present another consistent character. One-half of the leaf forms a nearly perfect arc. The difference in size and shape appears to depend upon the amount of variation in the outline of the opposite half of the leaf. When the "bulge" is greatest, the apex appears subrotund or obtuse; in the leaves with the least variation the apex may appear nearly acuminate.

The leaves are not crowded at the apex as in some of the other species. Like *B. sessilis* the distance between the internodes is greater and the leaves extend farther down the branchlet.

A very close relative is *B. holostyla* Huber. The only real variation in *B. holostyla,* as the name indicates, is the entire style. The leaves in the latter species are oblique but not as prominently so.

The style in *B. paniculata* is strongly 3-parted at the apex. However, I have studied flowers in which the style was not 3-parted at the stage examined, but possessing three lines at the apex showing that eventually the style would probably separate into three parts.

In describing *B. paniculata,* Spruce at the same time described *B. parviflora* from the same region in Peru. The flowers and leaves of *Spruce 4239* are smaller than those found in most specimens. However, there is such great variation in both parts as to make the specific status of *B. parviflora* untenable. I do not feel that it can be retained even as a variety as proposed by Wawra in Martius' Flora Brasiliensis.

This is the most widely distributed species as far as present collections are concerned, extending from Peru through Brazilian Amazonas and Venezuela into British Guiana.

12. **Bonnetia Dinizii** Huber in Bol. Mus. Goeldi 7: 302. 1913, in adnot.— Melchior in Nat. Pflanzenfam. ed. 2, 21: 150. 1925.— Gleason in Bull. Torrey Bot. Club 58: 397. 1931.

Small graceful tree (fide Ducke). Branchlets roughened by close arrangement of leaf-scars, glabrous, somewhat reddish. Leaves coriaceous, glabrous, somewhat concentrated at the apex of the branchlets, more distant on flowering branchlets, oblong-spathulate, 6–10 cm. long, 2–2.5 cm. wide, obtuse or rounded at the lightly retuse apex, long-attenuate at the base, subsessile (the petiole 2–3 mm. long), the margin finely denticulate, the veins many pairs, slightly elevated on both surfaces, rising from the midrib at an acute angle, extending parallel toward the margin and then sweeping upward. Inflorescence axillary, single- or three-flowered, the peduncles glabrous, up to 3 mm. long; pedicels very short, ca. 3 mm. long;

bracteoles 3 to a flower, quickly caducous, 9 in a verticillate arrangement at the base of the pedicels when three-flowered, at different intervals along the peduncle when one-flowered, glabrous, foliaceous in shape and texture, spathulate, 10–12 mm. long, ca. 4 mm. wide, the margin most minutely denticulate; sepals coriaceous, imbricate, glabrous, unequal, the outer two ovate, 10 × 6 mm., the inner three more rotund, the margin entire, scarious, more so on the inner sepals; petals 5, rose-colored, variously obcordate, 2–2.2 cm. long, ca. 2 cm. wide, retuse or emarginate at the apex, tapering toward a narrow base; ovary conical, glabrous, ca. 3 mm. across, tapering at the apex into a stout glabrous style 10 mm. long, strongly 3-parted for 3 or more mm. at the apex, a line of demarcation extending from the point of division down the length of the style to the base of the ovary. Capsule ca. 1 cm. long.

BRAZIL: Pará: "Hab. in campis ad fl. Ariramba Guianae brasiliensis," *A. Ducke 8094* (photo of type, Ch, G), Nov. 23, 1906 (small graceful tree with rose-colored flowers).—"Campos de l'Ariramba (Trombetas)," *A. Ducke 11298* (US; photo Ch), Dec. 2, 1910.

It may be that *B. Dinizii* is very localized. Very little material was available for this study, only two specimens, both collected by Ducke in the same locality. A photograph of the type shows that the original collection was very sparse and Huber's description was equally scanty. The above description of the flower was drawn from *Ducke 11298*, the second collection, and this was made from a single dissection.

Interesting characters worthy of notation are: (1) the stout style, strongly 3-parted at the apex, with a line or depression extending the entire length of the style and the ovary, showing clearly the eventual line of dehiscence; (2) the spathulate leaves, finely denticulate along the margin; and (3) the foliaceous bracteoles, three to a flower, arranged in a whorl in the 3-flowered inflorescences, or along the peduncle in the single-flowered inflorescences.

Bonnetia paniculata is the closest relative. It can be separated from the above species by the entire, oblique leaves, and the large, open, paniculate inflorescence.

13. **Bonnetia sessilis** Bentham in Hooker, Lond. Jour. Bot. 2: 363. 1843.—Walpers, Repert. Bot. Syst. 2: 801. 1843.—Schomburgk, Versuch Fauna Fl. Brit.-Guiana 1093. 1848.—Choisy in Mém. Soc. Phys. Hist. Nat. Genève 14: 160 (Mém. Ternstr. 72). 1855.—Wawra in Martius, Fl. Bras. 12(1): 327, pl. 67, fig. 1. 1886.—Oliver in Trans. Linn. Soc. ser. 2, 2: 271. 1887.—Szyszylowicz in Nat. Pflanzenfam. III. 6: 181. 1893.—Melchior in Nat. Pflanzenfam. ed. 2, 21: 150. 1925.—Gleason in Bull. Torrey Bot. Club 58: 397. 1931.
Kiesera sessilis (Benth.) O. Kuntze, Rev. Gen. Pl. 1: 62. 1891.
Bonnetia Phelpsii Gleason in Brittonia 3: 170. 1939.

Shrub or small tree up to 4 m. high. Branchlets glabrous, stout, brown-purple when very young, becoming gray, striate (probably in drying), the leaf-scars rather inconspicuous and as much as 1 cm. distant. Leaves coriaceous, glabrous, extending along the branch, elliptic to oblong-oblanceolate, varying in size, usually up to 6 cm. long and 3 cm. wide, occasionally up to 10 cm. long and 4 cm. wide, deep green above, dull green beneath, obtuse and emarginate at the apex, broadly cuneate at the

base, sessile, the margin entire, the veins elevated on the upper surface, subparallel and close, curved ascending, anastomosing near the margin into a conspicuous connecting vein, with a single additional marginal unbranched vein extending from the base to near the apex between the anastomosed margin vein and the margin. Flowers solitary in the axils of the upper leaves, the pedicel stout, reddish purple, glabrous, ca. 1 cm. long; bracteoles apparently 3, foliaceous, oblong-obovate, ca. 12 mm. long and 6 mm. wide, glabrous, rounded at the apex; sepals 5, imbricate, glabrous, coriaceous, the two outer smaller, 11–12 mm. long, nearly as wide, the inner three larger, up to 17 mm. long and 12 mm. wide; petals 5, white with rose or pink tips, triangular-obovate, conspicuously retuse, 3–3.5 cm. long, nearly as wide at the apex, tapering abruptly from the middle to the base; stamens very numerous, the filaments filiform, 8–11 mm. long, free except at the base, the anthers oblong, ca. 1.5–2.0 mm. long; ovary conical, 3-celled, about 3 mm. diameter, glabrous, tapering gradually at the apex into a stout style, a centimeter or more long, 3-parted at the apex, the stigmas 3.

BRITISH GUIANA: Between Ireng and Cotinga rivers, Roraima region, on high stony ground, alt. 900 m., *E. F. imThurn 11* (US), Oct. 1884–Jan. 1885.— Roraima, *R. Schomburgk 636* (Ch), 1842–43.— Kaieteur Savanna, (occasional tree 4 m. high, 6 cm. diam., flowers white) *B. Maguire & D. B. Fanshawe 23258* (A, NY), May 6, 1944.

VENEZUELA: State of Bolivar: Gran Sabana, between mission of Santa Teresita de Kavanayén northwest to Río Karuai, dry sandy and rocky open thickets on large mesa, alt. 1220 m., *J. A. Steyermark 59340* (Ch), Oct. 26, 1944 (common shrub 1–2 m. tall with coriaceous leaves, deep green above, dull green beneath, the inner sepals yellow-green with dull rose margins, the outer sepals dull green with rose-purple margins, the petals white with pink or pale rose around the tip).— Vicinity of "Misia Kathy Camp," on mesa between Ptari-tepuí and Sororopán-tepuí, alt. 1615 m., *J. A. Steyermark 60232* (Ch), Nov. 15–17, 1944 (common and dominant, the petals white with pink at tip).— Rocky savanna bordering Río Karuai, between La Laja and Santa Teresita de Kavanayén, alt. 1220 m., *J. A. Steyermark 60821* (Ch), Nov. 30, 1944 (dominant shrub 1–2 m. tall with white petals with pink or rose tip).— Mt. Auyan-tepuí, rocky savanna on burned mountain, alt. 1500 m., *F. Cardona 65* (US), May 21, 1937.— Mt. Auyan-tepuí, Guayana, rocky and humid savanna, alt. 1000–1200 m., *F. Cardona 218* (US), Sept. 1937.— Mt. Auyan-tepuí, alt. 1100 m., *G. H. H. Tate 1158* (NY, TYPE of *B. Phelpsii*), Dec. 7, 1937.— Mt. Auyan-tepuí, alt. 1850 m., *G. H. H. Tate 1162* (NY), Jan. 1938.— Cerro Guaiquinima, Alto Rio Paragua, Guayana, alt. 1760 m., *F. Cardona 1118* (US), July 15, 1944 (shrub 3 m. high).

The venation of the leaves in this species constitutes one of the outstanding characters of distinction and is quite consistent. Along the margin, more evident on the upper surface, are what appear to be two pairs of submarginal veins. The exterior pair of veins is the lighter of the two pairs and originates near the base of the leaf, extending upward and continuing without branching for the whole length of the leaf, occasionally fading out somewhat, near the apex. The inner pair is formed by the anastomosing of all the remaining major veins in the leaf near the margin and extending upward toward the apex. Gleason in describing *B. Phelpsii* drew attention to this excellent character. The leaves of the type of *B. Phelpsii* are larger than those found on the earlier known speci-

mens of *B. sessilis*, but with the addition of the excellent material of Steyermark this character ceases to be of importance, since both large and smaller leaves are found on the same specimen.

Most workers have considered the style in *B. sessilis* as entire. Wawra seems to have been the first to mention the style and he called it entire. Melchior and Gleason both used the entire style as a feature of distinction in their keys. In all the material studied above, none was found in which the style was entire. If such were the case, one would expect a three-lobed stigma rather than three distinct stigmas, as the case happens to be. The style is split only briefly at the apex but must be termed 3-parted rather than entire.

I have included the bracts in my description above. I presume these are quickly caducous, since they are seldom found even on flowering specimens.

14. **Bonnetia duidae** Kobuski & Steyermark, sp. nov.

Frutex 1–2 m. altus; ramulis crassis, juventute hirsutis, apice dense cicatricosis. Folia coriacea, ad apicem ramulorum conferta, lanceolata, sessilia, juventute supra hirsuta, 4.5–5.5 cm. longa, 1–1.4 cm. lata, apice acuta, basi rotundata, margine integra, costa basi expansa, supra plana basi hirsuta, subtus elevata, glabra, venis lateralibus numerosis, proximis (ca. 20 per cm.), parallelibus, sub angula acutissimo adscendentibus, supra ut videtur aciculatis, subtus prominulis. Flores apice ramulorum solitarii; pedicellis hirsutis, 1.3 cm. longis; sepalis 5, imbricatis, lanceolatis, ca. 3 cm. longis, 1 cm. latis, duobus exterioribus omnino dorsali hirsutis, tribus interioribus in parte medio dorsali hirsutis margine latiori scariosis; petalis 5, roseis, obovatis, papyraceis, 4–5 cm. longis, 1.5 cm. latis; staminibus numerosis; filamentis 8–10 mm. longis, liberis basi exceptis; antheris 1.5 mm. longis; ovario ovoideo, glabro, 3-loculari, multi-ovulato, stylo 1.4 cm. longo, apice 3-partito. Fructus non visus.

VENEZUELA: Territorio Federal Amazonas: Summit of Cerro Duida, Brocchinia Hills, dry ridge top, alt. 1700–1980 m., *J. A. Steyermark 58186* (TYPE, Ch), Sept. 1, 1944 (shrub 4–5 ft. tall; leaves in terminal rosette, coriaceous, deep rich olive green above, yellow or golden green beneath, petals deep rose).

The cortex of the terminal branchlets of this species is roughened by the elliptic leaf-scars which appear in such close proximity as to simulate the rough branches of some of the species of *Abies*. At the tips of the very young branchlets, between the densely occurring leaf-scars, can be found a hirsute pubescence which vanishes shortly after the leaves fall.

Only a very few leaves are to be found on the specimen. Steyermark in his field notes mentions the leaves as being "in a terminal rosette" — and so they appear. The lanceolate shape is unusual for the genus. The extremely close parallel veins ascend at a very acute angle and they are of such great number and are so close that one is reminded of the veining in *Calophyllum*. The midrib fans out noticeably at the base causing the leaf-scar to become wider than long. The upper surface of the very young or unfolding leaves is completely covered with a hirsute pubescence. The under surface is glabrous. As the leaf matures the pubescence disappears except for a tuft of hair at the base of the midrib on the upper

surface. Leaves can be found with hirsute midribs and ciliate margins in varying degrees of pubescence.

The pedicels and calyx-lobes are also hirsute. This pubescence on the long-lanceolate calyx-lobes constitutes a very important means of distinction. The two outer lobes are pubescent over the entire exterior surface. On the inner lobes, the pubescence is confined mostly to the portion exposed in the imbricate arrangement, the innermost lobe being completely glabrous. The margins of the lobes are scarious. As the intensity of the pubescence decreases, the width of the scarious margin of the inner lobes increases.

In most species, the width of the petals at the apex is about equal to their length. In this species, the width of the petal is only half that of the length.

The closest relative is *B. lanceifolia* Kobuski which differs from the present species in (1) the absence of pubescence on the leaves and branchlets, (2) the shorter and glabrous peduncles and sepals, (3) the shorter petals (2 cm.) as wide as long, and (4) the very few (5–7) pairs of veins inconspicuous on both surfaces of the leaves.

15. **Bonnetia lanceifolia** Kobuski, sp. nov.

Habitus ignotus (probabiliter frutex). Ramuli teretes, glabri, griseo-brunnei, foliis paucis apice confertis. Folia coriacea, glabra, linearilanceolata vel lanceolata, 4.5–6.5 cm. longa et 0.7–1.3 cm. lata, apice acutissima basi cuneata, sessilia, margine integra, venis 5–7 paribus, arcuato-adscendentibus, undique inconspicuis. Flores apice ramulorum solitarii, axillares; pedunculis glabris, teretibus, 4 mm. longis; sepalis 5, imbricatis, glabris, inaequalibus, duobus exterioribus ovato-lanceolatis, 10–11 mm. longis, ca. 6 mm. latis, apice acutis vel subacutis, tribus interioribus late ovatis, 12–14 cm. longis et 8 mm. latis, apice obtusis vel subrotundatis, margine scariosis; petalis 5, convolutis, flabelliformibus, 2 cm. longis, apice 1.5–2 cm. latis; staminibus numerosis; filamentis filiformibus glabris, ca. 6 mm. longis, liberis basi exceptis; antheris oblongis, ca. 1.5 mm. longis; ovario glabro, conico, ca. 4 mm. longo, 3-loculari, multiovulato, apice in stylum attenuato; stylo glabro, 5 mm. longo, apice ad 1.5 mm. 3-partito, stigmatibus 3. Fructus non visus.

VENEZUELA: Bolivar: Cerro Guaiquinima, Alto Río Paragua, alt. 1740 m., *F. Cardona 942* (TYPE, US), Oct. 1943.— Same locality, alt. 1600–1800 m., *F. Cardona 1126* (US), July 15, 1944.

This species in leaf-shape and leaf-size resembles *B. duidae* Kobuski & Steyermark. However, in *B. duidae* the upper surface is hirsute and the many veins, distinguishable on both surfaces, are so close together that counting becomes difficult.

Further differences between the two species can be found in the flower. In the present species, the peduncles are glabrous and measure but 4 mm. long, the sepals are glabrous, and not longer than 1.4 cm., the corolla (2 cm. long) is as broad at the apex as long, the anthers 1.5 mm. long, and the style 3-parted for only 1.5 mm. at the apex. In *B. duidae*, the peduncles are hirsute, measuring 13 mm. long, the sepals also are hirsute,

lanceolate, and 3 cm. long, the corolla (3 cm. long) is only one-third as wide as long, the anthers 6 mm. long, and the 3 styles separate to the base.

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ADDITIONAL NOTES ON THE CONVOLVULACEAE OF NEW GUINEA

S. J. VAN OOSTSTROOM

With one plate and one text-figure

IN A PAPER prepared for *Nova Guinea,* n. s. 5: 15–34,[1] the author gave an enumeration, with keys to the genera and species, of the Convolvulaceae known from New Guinea and adjacent islands. When that paper was already in press, a collection of Convolvulaceae made by Mrs. Mary Strong Clemens in the Morobe District, Northeast New Guinea, reached him, through the Arnold Arboretum. Moreover, a few specimens from other collections, mainly those of Mr. L. J. Brass, gathered during the Archbold Expeditions, were put at his disposal. A list of them with some notes and the description of a new species of *Erycibe* follow here.

The specimens are in the herbarium of the Arnold Arboretum (A); some duplicates are in the Rijksherbarium at Leiden (L).

Evolvulus L.

Evolvulus alsinoides L. var. **decumbens** (R. Br.) Van Ooststr. in Meded. Bot. Mus. en Herb. Utrecht 14: 38. 1934; id. in Nova Guinea, n. s. 5: 17.

NORTHEAST NEW GUINEA: Morobe District, Wantoat (Wantot), alt. 3500–6000 ft., flowers blue, *M. S. Clemens 11028,* Jan. 23, 1940 (A); id., Boana, alt. 2500–4500 ft., flowers pale blue, *M. S. Clemens 41628,* May-Nov., 1940 (A).

DISTRIBUTION: Australia, New Guinea, New Caledonia, Fiji Islands, Netherlands Indies, Philippines, Indo-China, China.

This is the only variety of the variable *E. alsinoides* L. occurring in New Guinea.

Erycibe Roxb.

Erycibe Hellwigii Prain in Jour. Asiat. Soc. Beng. 63: 84. 1894, note; Van Ooststr. in Nova Guinea, n. s. 5: 18.

NORTHEAST NEW GUINEA: Morobe District, Malalo Mission (Salamaua), margin of hill woods, alt. 800–900 ft., on small trees; fruit of brick colour, *J. & M. S. Clemens 3183,* May 25, 1936 (A); id., vicinity of Kajabit Mission, alt. 800–2000 ft., *M. S. Clemens 10791,* Aug.-Dec. 1939, a fruiting specimen (A); id., vicinity of Kajabit Mission, gully woods, steep above rivulet, alt. 1300 ft., tall vine; fruit bronze yellowish, *M. S. Clemens 40858,* Dec. 29, 1939 (A).

DISTRIBUTION: Endemic in New Guinea.

Erycibe Clemensae sp. nov. PLATE I; *fig. 1, a, b.*

Frutex (scandens?), ramulis junioribus subteretibus, mox rimis longitudinalibus nonnullis subangulatis, c. 2–3 mm. crassis, dense ferrugineotomentosis pilis stellatis 3–4(–6)-brachiatis, ramulis adultioribus glab-

[1] Not yet published.

rescentibus. Folia petiolata, petiolis (5–)7–8 mm. longis, tomentosis ut ramuli; laminis satis parvis coriaceis, ellipticis vel oblongo-ellipticis interdum obovatis interdum oblongis, apice obtusis et breviter acuminatis, basi acutis vel subobtusis, margine integerrimis, supra nitidis, subtus opacis, 5–7.5 cm. longis, (1.5–)2–3.5 cm. latis, glaberrimis nervo mediano utrinque excepto; nervo mediano nervis lateralibus utrinque 5 vel 6 supra impressis subtus prominentibus, nervis minoribus supra haud vel vix conspicuis, subtus indistinctis. Inflorescentiae tomentosae ut ramuli, axillares vel terminales, racemosae vel angustissime paniculatae, foliis breviores vel paullo longiores, (2.5–)4–10 cm. longae; flores breviter pedicellati, pedicellis 2–3 mm. longis tomentosis; bracteis lineato-oblongis, 1.5–4.5 mm. longis, concavis, externe tomentosis, interne glabris. Sepala concava

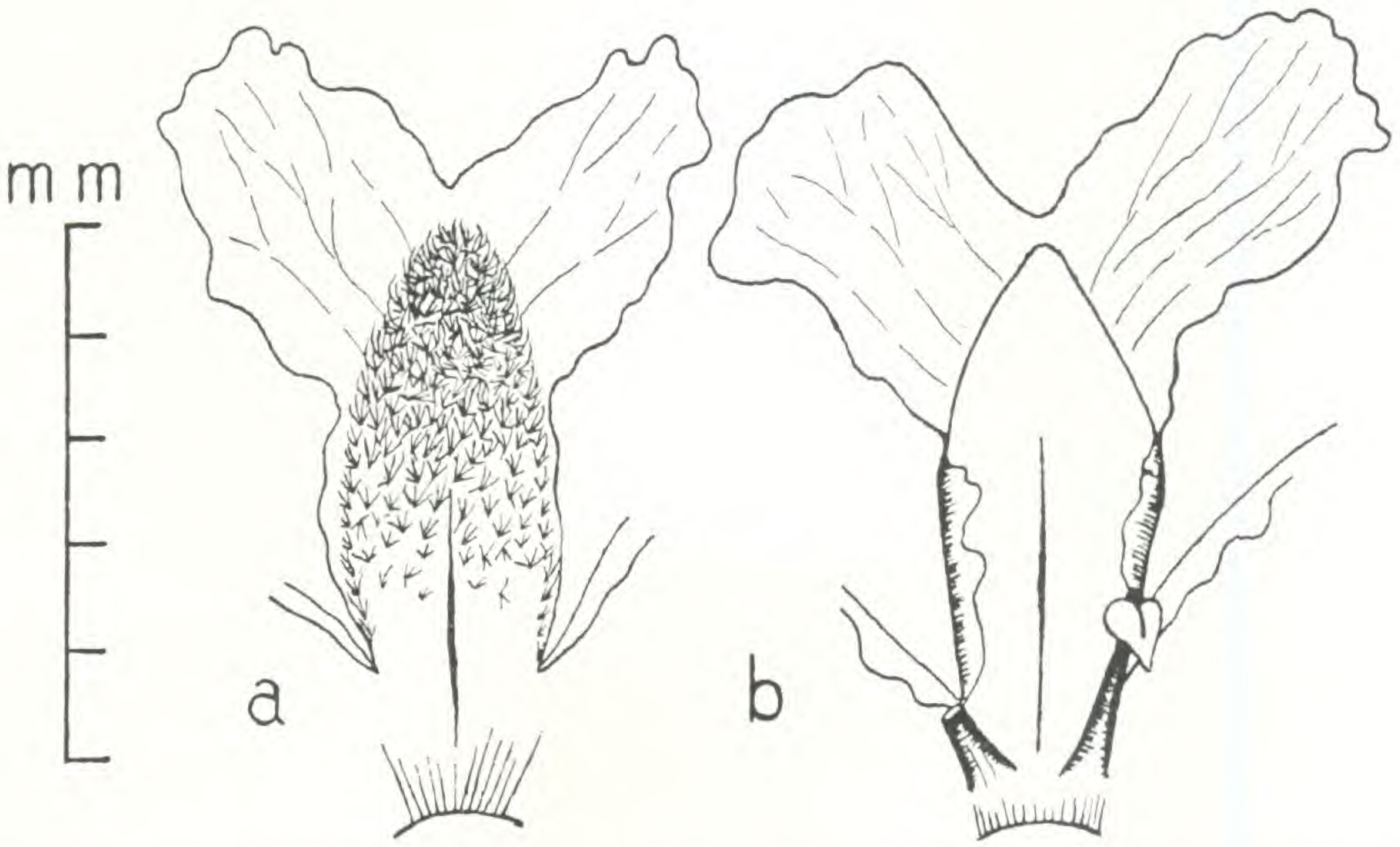

FIG. 1. *Erycibe Clemensae* sp. nov.: corolla-lobes, *a* from without, *b* from within.

orbicularia vel transverso-elliptica, apice late rotundata, 2.5–3 mm. longa, externe tomentosa interne glabra, interiora marginibus lateralibus tenuioribus. Corolla 5-partita, c. 7.5 mm. longa, basi glabra, fasciis 5 mesopetalis carnosis oblongis externe dense tomentosis; lobulis oblongis vel rectangularibus apice truncatis vel irregulariter grosse crenatis, supra fasciam mesopetalam breviter connatis, basi in fasciam mesopetalam decurrentibus, 3–3.5 mm. longis. Stamina prope basin corollae inserta; longitudo filamenti sesquiplex antherae; antherae incurvatae, cordiformes, acutae. Ovarium oblongum vel obovoideum, parte inferiore glabra, parte superiore tomentosa, stigmate apice radiatim 5-carinato.

NORTHEAST NEW GUINEA: Morobe District, Wareo, alt. 2000 ft., *Clemens 1622*, Jan. 13, 1936, TYPE in herb. Leiden, sub no. 937,351–618; another specimen in the herbarium of the Arnold Arboretum; id. Wareo, alt. 2000 ft., in hill forest, prob. a shrub, not high; flowers cream-yellowish, *J. & M. S. Clemens 1502*, Jan. 4, 1936 (L).

The Latin description has been based on the type; in *Clemens 1502* the leaves are ovate to oblong-lanceolate and larger than those of the type, up to 10 cm. long and 4.5 cm. wide.

Named in honour of the keen and indefatigable collector Mary Strong Clemens.

Erycibe nitidula Pilger in Bot. Jahrb. 59: 85. 1924; Van Ooststr. in Nova Guinea, n. s. 5: 18.

NETHERLANDS NEW GUINEA: Idenburg River, 6 km. SW. of Bernhard Camp, alt. 1200 m.; rain-forest canopy liana; fruits immature, *L. J. Brass 12803,* Feb. 1939 (A, L). NORTHEAST NEW GUINEA: Morobe District, Wantoat (Wantot), alt. 3500–6000 ft., *M. S. Clemens 11056,* Jan. 27, 1940 (A). PAPUA: Central Division, Dieni, Ononge Road, alt. 700 m., common in rain-forest; a very large liane, leaves dull, smooth, fruit orange-red, c. 1.5 cm. long and 1.3 cm. thick at base, slightly tapering to blunt apex, *L. J. Brass 3918,* May 12, 1933 (A).

DISTRIBUTION: Endemic in New Guinea.

The leaves of *Brass 3918* are much smaller than those of the type specimen as well as of *Brass 12803* and of *Clemens 11056;* the largest ones are 8 cm. long and nearly 3.5 cm. wide. In the type specimen, *Schlechter 16941,* the lower surface of the leaves is glabrous; in *Clemens 11056* it is rusty-tomentose, whereas in *Brass 12803* it is almost glabrous with exception of the densely hairy midrib.

Erycibe floribunda Pilger in Bot. Jahrb. 59: 84. 1924; Van Ooststr. in Nova Guinea, n. s. 5: 19.

NETHERLANDS NEW GUINEA: Slieber, 40 km. inward of Nabire, in fringing forest, alt. 300 m.; scandent; flowers white; fruit red, *R. Kanehira & S. Hatusima 12674,* March 9, 1940 (A).

DISTRIBUTION: Only known from Netherlands New Guinea and found north as well as south from the Central Range.

The leaves of this specimen are slightly broader than those of the other collections of the species.

In order to insert *Erycibe Clemensae* into the key to the New Guinean species of *Erycibe,* in Nova Guinea, n. s. 5: 18, this has to be altered as follows:

1a. Sepals nearly 5 mm. long; flowers in short and dense axillary and terminal racemes, at most up to 3.5 cm. long..... *E. grandiflora* Adelb.
1b. Sepals not exceeding 3 mm.; inflorescences mostly longer, less dense, racemose or paniculate. 2
2a. Reticulate venation between the lateral nerves distinct on both sides.....3
2b. Reticulate venation between the lateral nerves indistinct, at least above.....4
3a. Inflorescence a wide, many-flowered panicle; flowers small; sepals 1.5–2 mm. long; corolla c. 6–7 mm. diam..... *E. floribunda* Pilger.
3b. Inflorescence a narrow panicle or raceme, fewer-flowered; flowers larger; sepals 2.5 mm. long; corolla c. 8–9 mm. diam..... *E. nitidula* Pilger.
4a. Anthers acute to very shortly apiculate at the top; bracts minute.....5
4b. Anthers with a linear appendage at the top; bracts partly leaf-like and up to 10–12 mm. long. ..... *E. Schlechteri* Pilger.
5a. Corolla c. 7.5 mm. long; lateral nerves slightly impressed above; anthers acute. ..... *E. Clemensae* Van Ooststr.
5b. Corolla smaller; lateral nerves as far as visible slightly prominent above; anthers acute to shortly apiculate. ..... *E. Hellwigii* Prain.

Of *E. induta* Pilger the flowers are unknown. It is characterized in that the rusty brown tomentum on the branches and the lower leaf-surface persists for a long time.

Jacquemontia Choisy

Jacquemontia paniculata (Burm. f.) Hallier f. in Bot. Jahrb. 16: 541. 1893; Van Ooststr. in Blumea 3: 269. 1939; id. in Nova Guinea, n. s. 5: 20.

PAPUA: Central Division, Nakeo District, Baroka, savannah forests, alt. 50 m., common; twining on shrubs and tall grasses; leaves pale green; flowers pale pink, *L. J. Brass 3709,* April 1933 (A).

DISTRIBUTION: Tropical East Africa, Madagascar and adjacent islands, India (Central Provinces and Bombay to S. India; Ceylon; Assam), Indo-China, Malaysia, New Guinea (known from the eastern part of the island, not yet from Netherlands New Guinea), Bismarck Archipelago, New Caledonia, tropical Australia.

Merremia Dennst. em. Hallier f.

Merremia gemella (Burm. f.) Hallier f. in Bot. Jahrb. 16: 552. 1893; Van Ooststr. in Blumea 3: 297. 1939; id. in Nova Guinea, n. s. 5: 22.

NETHERLANDS NEW GUINEA: Idenburg River, Bernhard Camp, alt. 50 m., climbing on low seral vegetation of deeply flooded river plains; rare; sap milky; flowers yellow, *L. J. Brass 13993,* April 1939 (A, L).

DISTRIBUTION: S. E. Asia, Malay Archipelago, Philippine Islands, New Guinea, tropical Australia.

This is the typical form of the species; var. *splendens,* also known from New Guinea, has the corolla much larger, up to 3.5 cm. long.

Merremia quinata (R. Br.) Van Ooststr. in Nova Guinea, n. s. 5: 24.

NORTHEAST NEW GUINEA: Morobe District, vicinity of Kajabit Mission, open thicket, alt. 700–900 ft., vine, flowers white, *M. S. Clemens 10638,* Aug. 31, 1939 (A).

DISTRIBUTION: North Australia, Queensland, New Guinea. Mentioned from the Philippine Islands, Burma, and S. China, but it is not quite certain that the specimens from there belong to the species.

Operculina S. Manso

Operculina Turpethum (L.) S. Manso, Enum. Subst. Bras. 16. 1836; Van Ooststr. in Blumea 3: 362. 1939; id. in Nova Guinea, n. s. 5: 25.

NORTHEAST NEW GUINEA: Morobe District, Kajabit Mission, thicket trail, alt. 900 ft., flowers white, *M. S. Clemens 10830 bis,* Nov. 23, 1939 (A).

DISTRIBUTION: Tropics of the Old World; introduced in tropical America.

Ipomoea L.

Ipomoea polymorpha R. & S. Syst. 4: 254. 1819; Van Ooststr. in Blumea 3: 493. 1940; id. in Nova Guinea, n. s. 5: 28.

NORTHEAST NEW GUINEA: Morobe District, vicinity of Kajabit Mission, alt. 800–2000 ft., flowers lavender-purple, *M. S. Clemens 10694,* Aug.-Dec. 1939 (A).

DISTRIBUTION: Africa (Abyssinia), British India (?), Formosa, Malay Archipelago (E. Java, Lesser Sunda Islands), Philippine Islands, N. E. Australia.

This is, as far as I am aware, the first record from the main island of New Guinea, the species being already known from Thursday Island.

Ipomoea congesta R. Br. Prodr. Fl. Nov. Holl. 485. 1810; Van Ooststr. in Blumea 3: 500. 1940; id. in Nova Guinea, n. s. 5: 28.

NORTHEAST NEW GUINEA: Morobe District, Matap, alt. 4000 ft., flowers blue; on treelet in garden, *M. S. Clemens 41112,* April 2, 1940 (A).

DISTRIBUTION: Pantropical.

Ipomoea gracilis R. Br. Prodr. Fl. Nov. Holl. 484. 1810; Van Ooststr. in Blumea 3: 516. 1940; id. in Nova Guinea, n. s. 5: 30.

NETHERLANDS NEW GUINEA: Idenburg River, Bernhard Camp, scrambling over low stands of *Ficus* and *Hibiscus tiliaceus* fringing creeks of river flood plain at 50 m.; flowers pink, *L. J. Brass 13940,* April 1939 (A, L).

DISTRIBUTION: Coasts of the Indian and Pacific Oceans, also more inland: Madagascar and adjacent islands, British India, Ceylon, Indo-China, Malay Peninsula, Malay Archipelago, Philippine Islands, New Guinea, North Australia, Pacific Islands; according to Hallier in Mexico and the West Indies.

Ipomoea aquatica Forsk. Fl. Aeg.-Arab. 44. 1775; Van Ooststr. in Blumea 3: 528. 1940; id. in Nova Guinea, n. s. 5: 30.

NORTHEAST NEW GUINEA: Morobe District, vicinity of Kajabit Mission, alt. 800–2000 ft., *M. S. Clemens 10604,* Aug.-Dec. 1939 (A).

DISTRIBUTION: Pantropical.

Ipomoea alba L. Sp. Pl. 161. 1753; Van Ooststr. in Blumea 3: 547. 1940; id. in Nova Guinea, n. s. 5: 31.

NORTHEAST NEW GUINEA: Morobe District, Wantoat, alt. 3900 ft., flowers white; *M. S. Clemens 41175,* April 11, 1940 (A).

DISTRIBUTION: Pantropical.

Ipomoea asterophora Van Ooststr. var. **subglabra** Van Ooststr. in Blumea 3: 563. 1940; id. in Nova Guinea, n. s. 5: 33.

NETHERLANDS NEW GUINEA: Idenburg River, Bernhard Camp, climbing on fringe vegetation of deeply flooded rain-forest, alt. 50 m.; flowers pink, *L. J. Brass 13990,* April 1939 (A, L).

DISTRIBUTION: Endemic in New Guinea.

Lepistemon Bl.

Lepistemon urceolatum (R. Br.) F.v.Muell. Syst. Census Austr. Pl. 94. 1882; Van Ooststr. in Blumea 5: 344. 1943; id. in Nova Guinea, n. s. 5: 33.

NORTHEAST NEW GUINEA: Morobe District, Boana, alt. 3000 ft., common vine, *M. S. Clemens s. n.,* May 23, 1940 (A); id., Wantoat, open woods; flowers white, *M. S. Clemens 41097,* March 30, 1940 (A). PAPUA: Central Division, Mafulu, alt. 1250 m.; twining on forest regrowth bushes, *L. J. Brass 5535,* Sept.-Nov., 1933 (A).

DISTRIBUTION: Eastern part of the Malay Archipelago (Celebes, Moluccas), New Guinea, tropical Australia, Bougainville Island.

RIJKSHERBARIUM,
LEIDEN, THE NETHERLANDS.

EXPLANATION OF THE PLATE

Erycibe Clemensae sp. nov. Type in the Rijksherbarium, Leiden, the Netherlands.

ERYCIBE CLEMENSAE VAN OOSTSTROOM

DESCRIPTIONS OF NEW CHINESE PLANTS

FAITH CHUN

TYPES of the new species described below are deposited in the herbarium of the Botanical Institute of San Yatsen University; duplicates have been set aside for the herbaria of the Arnold Arboretum and the Institute of Economic Botany of the National University of Kwangsi.

Capparis urophylla sp. nov.

Frutex vel arbuscula usque ad 4 m. altus (fide Liang) inermis floribus exceptis glaberrimus ob aspectum delicatum satis jucundus ramulis teretibus albido-viridibus hornotinis filiformibus modice elongatis annotinis gracilibus anno tertio 4–5 mm. crassis. Stipulae caducae ignotae. Folia decidua disticha tenue herbacea tempus fructu chartacea supra laete viridia subtus pallidiora sicco flavescentia subconcoloria ambitu satis variabilia elliptica elliptico-lanceolata infima interdum elliptico- vel ovato-trapezoidia basi cuneata circa medium in caudam longam contracta; caudae laminis paululo longiores vel subaequantes graciles medio 1.5–2 mm. latae rectiusculae curvatae vel interdum falcatae apice obtusae vel truncatae; laminae (cauda inclusa) 3.5–7.5 cm. longae 1.2–2.2 cm. latae margine paulo incrassata sicco crebre obscureque crenulatae costa et nervis utrinsecus circ. 5 obliquis procul ante marginem arcuato-anastomosantibus venulosis tenuibus siccitate utrinque eminentibus trabeculis crebris sub lente tantum prominulis; petioli filiformes 4–5 mm. longi supra canaliculati. Flores mediocres axillares solitarii nutantes albi pedicellati; pedicelli graciles 8 mm. longi teretes; sepala 4 imbricata chartacea concava minute glanduloso-maculata utrinque plus minusve floccoso-tomentella inaequalia, exteriora 2 majora 4.5–5 mm. longa 3–3.5 mm. lata uno late obovato apice leviter incurvo altero subrotundato valde cucullato, interiora angustiora 4 mm. longa 2 mm. lata elliptico-oblonga; petala 4 tenuia utrinque floccoso-villosula margine ciliata subaequalia 5.5 mm. longa, latiora elliptico-oblonga 2.5 mm. lata, reliqua spathulato-oblonga 2 mm. lata; stamina circ. 18, filamentis filiformibus 10–12 mm. longis ante anthesin sinuoso-pluriplicatis; antherae dorso affixae oscillatorii brunnescentibus anguste ovoideis 1.2 mm. longis basi breviter discretis apice minute umbonatis; torus crassus glaber obscure 4-lobatus. Gynophorum 6–14 mm. longum glabrum. Ovarium purpurascens glabrum ovoideum sursum leviter contractum, placentis 2 ovulis paucis. Bacca globosa 6–8 mm. diam. flava dense papillosa, pedicello 12 mm. longo suffulta.

KWANGSI: Hsing-On Hsien, Hwa-Kiang Hsiang, Lao-Fu Shan, shrub at the foot of the hill, leaves green above, pale green beneath, flowers white, June 7, 1936, *Z. S. Chung 81701* (TYPE); same district, Hwa-Kiang, side of stream, shrub in young fruit, Nov. 3, 1937, *Z. S. Chung 83676;* Pai-Sou Hsien, Liang-Chiang enroute to Bai-Sou city, base of San-Ta-Ling, shrub 1.3 m. tall, fruits yellow, Aug. 17–18, 1937, *Y. W. Taam 6.* KWANGTUNG: Shi-Wan-Ta Shan, Ta-Chi-Hsu, in dense woods of ravine, in young fruit, shrub 4 m. tall, Aug. 10, 1937, *H. Y. Liang 70019.*

This is a very distinct species of a beautiful delicate habit, with usually

long-tailed leaves, solitary small white 4-merous flowers, comparatively few stamens on long flexuously folded filaments, and a 1-celled ovary with apparently few-ovuled placentas.

Acer bicolor sp. nov.

Arbusculus. Ramuli robusti obtuse angulati sine lenticellis hornotini purpurascentes annotini nigrescentes vetustiores griseo-brunnei tenuiter striati lenticellis perpaucis instructi. Gemmae atro-virides ovoideae obtusae 3 mm. longae, perulis paucis exterioribus subrotundatis interioribus ovatis glabris margine breviter ciliato excepto. Folia coriacea glaberrima quinqueloba lamina latiora quam longa 12–20 cm. lata 8–14 cm. longa, supra olivacea nitida subtus intense purpurascentia, basi cordata sinubus apertis profundis interdum subtruncata sinubus fere occultis; lobi dimidiam laminam attingentes, duobus inferioribus fere horizontaliter divaricatis quam ceteris vix minoribus, lanceolato-ovati subito longo-acuminati apicibus mucronulatis margine integris vel obscure crenulatis raro versus apicem loborum inciso-paucidenticulatis; nervi primarii validi elevati supra initio purpureo-colorati nervis secundariis nervulisque densis elevatis conspicue reticulatis conjuncti. Inflorescentia andro-monoclina terminalia paniculata multiflora pedunculo glabro tereti 2.5–4 cm. longo insidens; pedicelli circ. 5 mm. longi glabri; sepala 5 viridia concava oblonga vel ovato-oblonga, 4 mm. longa, obtusa extus glabra intus sericeo-floccoso-villosa margine ciliata; petala 5 sepalis breviora glabra suborbicularia 3 mm. longa margine undulata; stamina 8, antheris elliptico-oblongis, 1.5 mm. longis, filamentis glabris, 4 mm. longis; discus crassus extra-stamineus; ovarium dense pilosum, stylo curvato glabro vix distincte bilobulato, 2 mm. longo supra medium canaliculato et papilloso apice decurvato coronans. Fructus non visus.

KWANGSI: Yao Shan, Lo-Hsiang, in flower, May 9, 1929, *S. S. Sin 8958,* Bot. Inst. *Herb. No. 124596;* Ku-Chen, June 27, 1934, *S. S. Sin 23311,* Bot. Inst. *Herb. No. 124595;* Hsiang Hsien, Shang Ku-Chun, Five Finger Mountain, small shrub 4 m. tall on peak, leaves green above, purple-red beneath; petals white, June 19, 1936, *C. Wang 39468* (*Bot. No. B/581*) (TYPE).

This species belongs to the Sect. *Spicata* but is no more closely related to any one species than to another of that Section. It has the villose sepals of *Acer erianthum* Schwerin with the inflorescence of *A. sinense* Pax. From both of these, our new species differs in large, subequally 5-lobed, strictly glabrous leaves with the two basal lobes as large as the upper ones and horizontally spreading. In all the flowers examined from specimens preserved in formalin the style is not distinctly bilobed as in most species of the genus but has the stigmatic portion separated only by a longitudinal groove and in time becomes strongly revolute.

This is a most attractive maple, with beautiful strongly-veined two-colored leaves, the brilliant purplish red color of the lower surface contrasting vividly with the bright olive-green of the upper surface. Efforts are being made to collect seeds of this lovely plant for introduction as a garden ornament.

Mahonia subimbricata W. Y. Chun & F. Chun, sp. nov.

Arbuscula ut videtur humilis caulis (partibus inferioribus ignotis) hornotinis luteo-viridibus nitidis striatis 8 mm. crassis basi perulis arcte

imbricatis purpurascentibus scariosis striatis apice obtusis erosulis involutis. Folia multa conferta, 12–22 cm. longa, rhachi subterete tenui unilateraliter sulcata basi stipulis binis subulatis rectis 4–5 mm. longis suffulta, internodiis brevibus antrorsum decrescentibus posteriore vix ultra 20 mm. longo anteriore 5–10 mm. longo, foliorum paribus 11–13 porrecto-patentibus jugo infimo multo minore 6–8 mm. supra petioli basin inserto, secundo ab aliis remotiore, jugis superioribus contiguis antrorsum manifeste imbricatis. Foliolum terminale maximum 2.5–4 cm. longum oblongo-ovatum symmetricum basi rotundatum vel cordatulum, margine 5–7-dentatum, foliola lateralia parva inaequalia a medio folii utrinque sensim decrescentia, media 2.5–3.5 cm. longa circ. 1.5 cm. lata, superiora inferioraque 1.5–2 cm. (raro usque ad 2.5 cm.) longa, ovata vel elongato-ovata subito longeque acuminata basi truncata margine anteriore 3–5-dentata posteriore 6–8-dentata dentibus erectis irregularibus tenuibus spinuloso-apiculatis spinulis leviter incurvatis, rigide coriacea supra olivacea subtus glaucescentia (e nota ad vivum), sicco supra opaca nervis primariis 3 impressis tenuibus evenulosis supra medium evanescentibus subtus flavida subnitida nervis primariis leviter tantum elevatis venulis indistinctis. Racemi circ. 13 aggregati 7–9 cm. longi simplices pluriflori floribus inter se 4 mm. distantibus basi bracteis scarioso-membranaceis elliptico-loratis circ. 12 mm. longis 5 mm. latis purpurascentibus striatis apice oblique truncatis fibrilloso-erosulis instructi. Flores (pauci tantum satis expansi) flavi; bracteolae anguste ovato-oblongae acutae concavae incurvatae pedicellis ad 3 mm. longis tenuibus fere duplo longiores; sepala concava 3 externa minima late ovata, 2 mm. longa 1.5 mm. lata 5-nervia, cetera obovato-oblonga 3 mm. longa, 3 media 2 mm. lata 5-nervia, 3 interna leviter angustiora 3-nervia; petala sepalis internis conformibus paullo vel vix minora 1-nervia nervo supra medium biramoso, apice obtusa integra basi attenuata biglandulifera glandulis lineari-ellipticis divaricatis. Stamina petalis paulo breviora, filamentis linearibus levibus, antheris aequilongis angustioribus, connectivis obtusis. Ovarium anguste ellipsoideum 2 mm. longum estylosum uniovulatum (an semper?), stigmate magno discoideo. Bacca ignota.

KWANGSI: Ching-Hsi Hsien, An-Teh District, Tung-Kong Village, shrub on forested slope, leaves olive green above, glaucous green beneath, flowers yellow, Sept. 21, 1935, *S. P. Ko 55791* (TYPE).

We have not been able to associate this neat and very attractive plant with any of the Asiatic species of the genus, on account of its distinctive foliage. The rhachis of the leaves has relatively short internodes, which decrease in length upwards so as to make the upper leaflets overlap each successive pair. Furthermore the leaflets are not uniform in size, those near the middle of each leaf being largest, with a noticeable gradual diminution in length towards both extremities. The leaves are reminiscent of those of *M. conferta* Takeda, but that species has larger, differently shaped leaflets with fewer coarser dentations, larger more numerous crowded flowers with bifid petals, and a distinct style.

INSTITUTE OF ECONOMIC BOTANY,
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THE ARNOLD ARBORETUM DURING THE FISCAL YEAR ENDED JUNE 30, 1948

Horticulture. — During the past year special efforts have been made to improve the grounds and rearrange the plantings so that they can be maintained with a minimum of hand labor. Labor costs have doubled since 1942. Less labor was used on the grounds than during the previous year, but mechanized equipment has made the labor more effective.

Ten tons of fertilizer and several tons of lime were applied to various collections, particularly the elms, lilacs, rhododendrons, maples and viburnums. The response of the trees and shrubs justifies the fertilizer application.

The "Blitzer" mower, drawn by a tractor, has proved to be a major factor in keeping the grounds neat, and in reducing fire hazards. The improvement is especially striking in the Conifer Collection.

The mulching of the trees and shrubs with spent hops from a local brewery has been very effective in promoting growth and reducing weeds. Last winter we obtained 2824 cubic yards of peat moss at a cost of $882. Much of it was distributed along Meadow Road where we are to plant an azalea collection, some was used in the Shrub Collection and a considerable stock pile has been accumulated. Peat moss is now used in practically all new plantings.

Many of the plants in the Shrub Collection have been rearranged, and eventually we plan to move the vines to the wall along the Arborway. The shrubby *Cornus* were moved to the Bussey Hill area. The best of the deutzias, spiraeas and weigelas have been moved to the Shrub Collection and the rest moved to Weston.

Mr. John S. Ames contributed $3000 to be used specifically for the renovation of Peter's Hill, an area long neglected due to lack of labor. Work was started in June and we expect to complete the removal of dead and surplus trees by fall so that the area can be seeded to grass and new plantings started as soon as possible.

A collection of 36 color prints was made and displayed at the Spring Flower Show. Both color and black and white photographs have been made for projection and publication. Our horticulturist has given 15 lectures during the year, largely to garden club groups. The usual number of ARNOLDIA, our journal of popular information, have been issued.

The assistant horticulturist spends most of his time checking the names of plants removed from or added to the collections so that our records are always up to date. During the year, 4173 display labels and 1246 record labels were made.

We received 1087 cuttings or scions, 974 packages of seed and 861 plants during the year. Our propagator grew 60 flats of seedlings, rooted 652 cuttings and made 2,290 grafts. He distributed 317 cuttings, 695

packages of seeds and 459 plants. In addition, a total of 532 packets of *Metasequoia* seeds, which were sent to Dr. Merrill from China, have been distributed over a wide area.

The Case Estates in Weston have proved to be of great value in the Arboretum work. The nurseries now include 1600 kinds of plants. Many of the less ornamental shrubs are in a permanent planting and consist of 418 species and varieties. The hybrid seedlings developed at the Arnold Arboretum are tested at Weston. Approximately seven acres of land are used for tree breeding test plots and half an acre of hybrid corn was grown for the Bussey Institution. The Department of Landscape Architecture is slowly developing its project and the Weston Garden Club assists with the perennial garden and in return obtains cut flowers for its work in local hospitals. Several horticultural experiments are being conducted on this land.

A new hybrid cherry has been distributed to cooperating nurserymen. This hybrid is a semi-double flowered dwarf plant which retains its flowers for a long period. It has been named "Hally Jolivette," the maiden name of the wife of the plant breeder. Several apple hybrids have been distributed for testing, but have not yet been named. Some of the new *Forsythia* hybrids show much promise. Root stock studies are being continued to discover dwarfing stocks for both ornamental and commercial trees and shrubs. Cytological studies have been largely confined to work with x-rays.

Comparative Morphology. — Professor Bailey and his co-workers have continued their investigation of the comparative morphology of various dicotyledonous families with special emphasis upon the structure of carpels and stamens, nodal anatomy and pollen morphology. A wealth of carefully preserved material, collected by Dr. A. C. Smith in Fiji, has enabled Dr. B. G. L. Swamy to complete a very thorough and significant study of the Degeneriaceae. Mr. J. E. Canwright is completing a comprehensive study of the Magnoliaceae, Mr. R. W. Vanderwyk of the Annonaceae and Mrs. Lillian N. Money of the Monimiaceae. Mr. Armando T. Hunziker, a Research Fellow from Argentina, is initiating an investigation of the Lardizabalaceae. Two observations of particular significance have been: (1) that the New Caledonian endemic, *Amborella tricopoda* Baill., is a new morphological type of vesselless dicotyledon, and (2) that the wood of the much discussed *Metasequoia* contains traumatic resin canals indicative of relationship to *Sequoia* rather than to *Taxodium* or other genera of the Taxodiaceae.

The Herbarium. — During the year 9395 specimens were mounted, of which 8480 were added to the herbarium, which now contains 634,487 specimens.

Accessions during the past fiscal year numbered 59,955 specimens, of which only 12,112 came through exchange, the greater part coming from subsidized exploration and work of our staff. Some of the more important

exchanges consist of 4803 specimens from the Natural History Museum, Paris (material from southeastern Asia, New Caledonia, and western Africa), 1657 from the Botanic Garden, Singapore (material from Malay), and over 1200 specimens from the Rijksherbarium, Leiden (material from Siam). Our largest accession is the work of a staff member, the 26,000 specimens assembled by Dr. A. C. Smith during his nine months of field work in Fiji. As results of subsidies given to Chinese botanists in previous years, over 15,000 Chinese specimens were received from the National Szechuan University, over 2400 from the Yunnan Botanical Institute, and a smaller number from National Central University, Nanking. Of special interest among these latter collections is material of recently discovered living plants previously known only as fossils. As a result of our close co-operation with Chinese botanists the Arboretum was able to acquire seeds of the Metasequoia and make the first general distribution of them to botanic gardens and horticulturists in America and Europe.

A total of 14,658 specimens was sent out from the herbarium, most of which (907 unmounted and 10,972 mounted) represent continuation of inter-institutional transfer of American tropical material to the Gray Herbarium in Cambridge.

The Arboretum has received 39 requests for the loan of herbarium material. These came from 12 American and 9 foreign institutions and involved 3902 of our specimens. For the study of our own staff, 2274 specimens were borrowed from 6 American and 6 foreign institutions.

Professor Rehder has continued work on the bibliography and synonymy of American cultivated trees and shrubs. The large volume, now mostly printed, will probably appear next year. Dr. Merrill has finished his detailed study of the botanical works of Rafinesque and sent his bulky manuscript to the printer. He sailed for Europe May 15 to attend the symposium on botanical nomenclature held at Utrecht, Holland, being one of three delegates representing the United States. Having three weeks in England and three in Holland, he was able to accomplish considerable botanical work in the major herbaria at London, Kew, and Leiden. Dr. Johnston finished a report on some of his botanical work done in Panama during the recent war and has resumed work on the West Indian and Central American Boraginaceae, preparatory to writing an account of the family for the Flora of Trinidad. Dr. Smith, absent during a year of field work in Fiji, returned to the Arboretum in March and began organizing his extensive collections for study. Dr. Kobuski furthered his studies of the Theaceae. In addition to his other duties he assumed rather heavy editorial duties during Dr. Smith's absence. Dr. Caroline Allen finished her very detailed and critical account of the Panamanian Lauraceae and worked on representatives of the family from northern South America. Dr. Perry continued work on the Papuan flora and started studies on the Chinese flora.

Bibliography. — Dr. Frans Verdoorn continued to edit his Chronica Botanica, "A New Series of Plant Science Books," and the Annales Crypto-

gamici et Phytopathologici, and established a new serial, Pallas, for the publication of reprint editions of rare classic scientific works. Volume 1 of Biologia, a report of international activities in the biological sciences, was concluded in December 1947. Volume 2 will be issued this autumn as a small annual. Work on the Index Botanicorum continued, as in previous years, with two administrative assistants devoting almost full time to this work. The card files, needed before the actual compilation of the Prodromus to the Index can be started, are now nearing completion.

The Library. — During the fiscal year just ended about ninety percent of the pre-Linnaean books were sent to the Houghton Library on temporary deposit (until such time as we shall have better facilities for their storage). The present library space available here for these books is not the best. The upper library gets too hot in summer and too cold in winter, and as a result the old leather bindings suffer greatly. If any of these books are urgently needed, it is a matter of from twenty-four to thirty-six hours for the Harvard messenger to bring the books over from Cambridge. These books are shelved as a unit, in the same order in which they were shelved at the Arboretum. The remaining ten percent are a "must"; they are needed here. The latter have been treated with a leather preservant, and those in need of repair have been repaired and restored by a craftsman.

The resulting empty shelves have enabled the librarian to remedy the overcrowding of other shelves, namely those containing monographs; a job of shelf-reading and dusting accompanied the moving.

There has been some rearrangement of books in the main library. In several sections the books have been given individual numbers, thus making the finding of references much easier for the staff.

We continue to fill the gaps in foreign periodical literature, German as well as Japanese; some through journal exchanges, some through the Library of Congress Mission. We were very fortunate in receiving microfilms of several German periodicals, the originals of which were destroyed during the war.

Interlibrary loans were heavier than in previous years, 685 volumes having been borrowed or loaned; there were also many requests for typed copies of original descriptions, microfilms, and photostats.

The photograph file is being brought up to date, especially that section which deals with the Arnold Arboretum.

There were 248 bound volumes added to the library, bringing the total to 46,765; 185 pamphlets were catalogued and put into pamphlet bindings, and these now total 14,148.

The main catalogue received additions of 825 cards, and the Gray Herbarium cards were increased by 4,629.

A new steel file was acquired for the slips of the Polynesian bibliography.

Financial report. — Endowment funds received during the year included $360,000.00 from the Louisa W. Case estate, $64,790.91 from the

Georgiana Wells Sargent bequest, and $10,000.00 from the William Prescott Wolcott bequest. Funds for current use include $3,000.00 from John S. Ames for the specific project already described, $400.00 for Chinese Exploration, $50.00 for the William H. Judd Fund, $6,680.00 for the Rafinesque Publication Fund, and $8,583.65 from the "Friends of the Arnold Arboretum" for improvement of the grounds.

The total income for the year was $170,134.00 and expenses were $172,428.00. The deficit was greater than indicated because the publication fund and the grant for special work on Peters Hill are to be expended largely during the following year. The deficit during the past three years has amounted to more than $30,000.00, and has practically wiped out the credit balance built up during the war years. The added endowment and contributions from the Friends of the Arnold Arboretum should permit normal maintenance and operations during the coming year. However, we have not replaced the plant pathologist who retired in 1940, nor the two taxonomists, an assistant librarian and a technician, who retired or resigned last year.

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KARL SAX,
Director

Staff of the Arnold Arboretum

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